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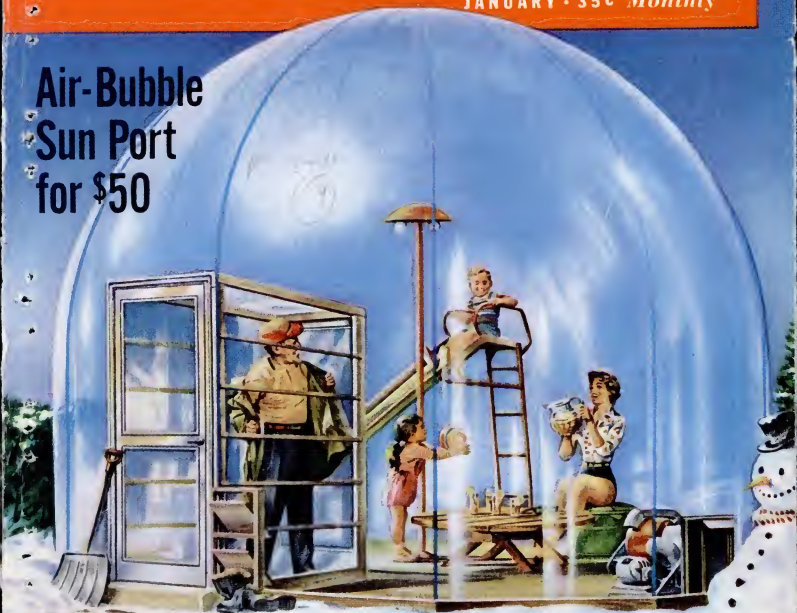
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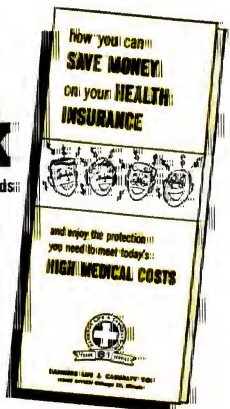
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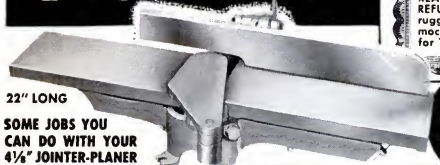
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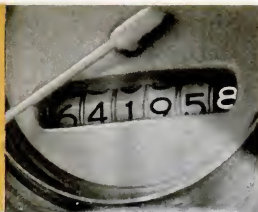
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Popular Science

January, 1961

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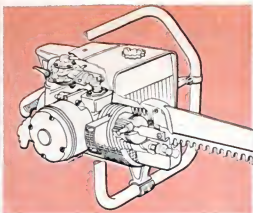
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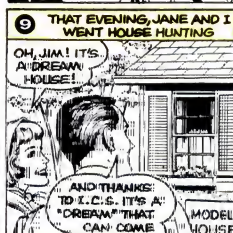
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I'M READY NOW, MR. WALSH



6 THEY GAVE ME SOME SIMPLE ASSIGNMENTS... AND I SURE SURPRISED THEM!
SAY, WHERE DID YOU LEARN ABOUT PUMPS?
SAME PLACE YOU DID, JOE... I.C.S.



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PS Readers

TALK BACK



He'd Vote for a Change

HAVING served on an election board, I am familiar with voting machines and appreciate your accurate description of how they work [Oct.]. But I disagree on their perfection.

Actually, the voter knows from nothing how his vote is recorded. The machine may have failed to operate as intended or, as has happened, the mechanism may have been intentionally maladjusted. The voter has no way of seeing this.

The voter will continue to risk disfranchisement until the machines are redesigned. I'd arrange it so that after a voter swings down the chosen pointer, he must pencil an X on a spot on a roll of paper uncovered when the pointer is swung down. The pressure of the pencil on the paper would trigger the registry cam into engagement with the digit counter. The recount must be preserved and the voter must be able to observe his marking of his selection.

L. W. JOHNSON, Miami, Fla.

Darkest Day in Pa.

TEN years ago, on Sept. 24, 1950, from about 2:30 to 5:00 p.m. we were in darkness. The area covered was Pennsylvania west to Chicago. The radio announcers went crazy, people got excited, some felt it was the end. It gave everybody a very weird feeling. Others capitalized on it—a local drive-in theater opened for a special show.

As far as I know, no explanation of the phenomenon was ever given. Have you ever heard what caused it?

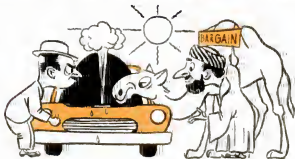
P. J. REYNOLDS, Warren, Pa.

Says a 1950 Weather Bureau report: "September 24th will be long remembered by Pennsylvanians for the weird unearth-

ly effects produced when the sun and sky became obscured (from the Great Lakes to the Atlantic Ocean) by a more-than-mile-thick layer of forest-fire smoke which had been carried southeastward by strong to gale force upper-air winds. Forest fires in western Canada were the source of the smoke . . . It was an eerie darkness for there was no noise with its approach as in a thunderstorm; no precipitation as in a snowstorm; no wind as in a tornado . . . Weather observers needed flashlights to read their instruments."

He's for Adjustable Thermostats

I CAN'T agree with you that thermostats are just as useful in summer time as in winter ["Tune-Up Quiz for Car Owners," Sept.]. In this part of the world, where temperatures for three months are never below 100 degrees F, thermostats are removed when the car is new, as they generally cause overheating. As the water



and the engine are already warm, there is no need for prolonged warm-up. Thermostats are used to maintain an even temperature throughout, and they are most useful when the temperature difference before and after running is considerable. It's a pity that car manufacturers do not install adjustable thermostats. So my advice is to remove it for summer and replace it for winter.

E. A. ASHOO, Basrah, Iraq.

Those Detroit "Kits"

BRAVO, I say, to Thomas Appel ["PS Readers Talk Back," Oct.]. He is not alone in his conviction that Detroit is selling kits. The weekends you're not busy tightening up the loosely thrown-

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together parts, you're busy attacking the rusting brightwork. With half the population using the car for commuting to the job, and leaving it weathering five days a week, why all that chrome?

I have one suggestion for dealers and builders alike: Use your car in precisely the way the consumer uses his; forego the special servicing you enjoy and try a dealer who doesn't know you from a local plumber. You'll soon learn about



poor quality control, inefficient servicing, and that unkindest cut of all—the cold shoulder.

J. L. MASON, Chicago.

... I WAS glad to see Detroit specifically mentioned as the source of the "buckets of bolts" on the road. There is a U. S. car built—in South Bend—that is capable of 100,000 miles without major repairs, one most certainly not a repair-it-yourself-kit. It's the Studebaker.

I've owned several and now have a '54 Champion with just under 60,000 miles on it. It is far from the scrap heap, and the most expensive replacement or repair so far has been a new battery.

I suggest that Mr. Appel check into all the "firsts" that were pioneered by Studebaker and today are used by all car manufacturers. If Oscars were awarded for the industry, Studebaker would have a roomful of them.

DON MCKAY, Kelowna, B. C.

Sticky Problem

THE article on epoxies ["The Goo with a Million Uses," Oct.] hit us in a tender spot. GOO is a registered trademark for our permanent rubber-base adhesive. Your title may tend to confuse our customers who depend on our all-purpose GOO for all their sticky problems. It comes in a single tube—no mixing—and will hold 'most anything together.

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"I made nearly \$8,000.00 in one transaction that required only about 30 days..." A.M.E. "On my very first transaction I made \$904.00 for just 4 days work... My wife and I started this business together..." D.M.C. "With an initial investment of less than \$100, I have grossed a profit in the neighborhood of \$12,000.00. Now with your help my future is secure..." D.L.S. "I was stumbling along on a time card job without much future. Now I can enjoy the freedom and security of a business of my own which has no end or limit..." W.J.J. Many beginners start this way with little or no capital under unique "Drop Ship Plan."



...Plan shows where you get buys like these for big profit U.S. sales. Prices shown are DIRECT FROM SUPPLIERS ABROAD. **DO NOT ORDER FROM US**

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Now you can get exciting Imports at trifling cost abroad and sell them by mail order to friends and stores. New Plan starts you now in full or spare time without capital or previous experience. Just imagine *huge profit* you make on 17-jewel watch (shown below) you can get for only \$2.87 in Europe—transistor radio at just \$3.02—tape recorder or Derringer pistol. Mellinger shows you how to order *direct* in large or small quantities or single units. Shows how you make your profit in advance. Shows how you can put past jobs, hobbies and interests to work making you extra profits.

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Following the streamlined Mellinger Plan, you deal directly with original overseas sources, saving time, eliminating middleman profits. No catalog "schemes" or franchise distributor "deals." Mellinger makes no profits on your imports. The profits are *all yours!* You are shown how easily you can get FREE Samples, how to

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in your spare time

to Fix Electric Appliances



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You need proper equipment to service today's automatic appliances. With this course you get parts to build professional type, multi-use Appliance Tester. You learn to use it. Takes guess work out of servicing. Mail coupon for FREE book and Sample Lesson. See how easy it is to learn. Find out about NRI—a school that for more than 40 years has been training men, through home study, for success, good pay jobs. Our reputation, record, experience back up this course. Address: National Radio Institute, Dept. BA1, Washington 16, D. C.



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—was worth the year's subscription. I needed it to save my washing machine.

In return, here's a tip for you: For a good paint remover, use one part baking soda to two parts fresh lime mixed with water to a thick-cream consistency. Apply one or more coats. Scrape off in 20 to 30 minutes.

H. H. MOORE, Metairie, La.

One More Smith Flyer

MAY I add another to the growing list of proud owners of Smith Flyers—my son-in-law, William Bullock of Erie, Pa.

As you can see from the picture, his car is still in the same condition as when



purchased for him, brand new, by his Dad. Bill's two girls (one seated near the front wheels) and the other children of their neighborhood get a big bang out of riding in it.

LEO BABO, Erie, Pa.

Cotter-Pin Sanding Drums

I've just read Harry Wheeler's tip on how to make small sanding drums [Nov., p. 152]. Tell him there's a simpler way.

Take regular cotter pins—all lengths, from two-inch on up—and wrap emery paper around them to any size you want. Slip the paper into the slot and make the wrap tight, but don't glue the ends. As you put the drum against the work, it will come to size. When the paper gums up or wears out, just unroll one round, cut it off, and you're in business again.

If you want longer drums than you can make with cotter pins, split (to the head) a 1/4-inch bolt of any length.

RAYMOND SMITH, Cucamonga, Calif.

Tallest Structure Moves Again

NEITHER Maine nor Moscow can claim title as home of the world's tallest structure ["PS Readers Talk Back," Oct.]. When KFVS-Television switched over to its new 1,676½-foot tower, in October, Missouri won that distinction.

The tower stands on a high hill 8½ miles from Cape Girardeau. Its weight

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men with. Electronics training than for any other category . . . and these are better than average jobs. Prepare for one of these jobs by taking NRI training at home in your spare time. Hold onto your present job while training. In a short time you, too, should be ready for a bright future in Radio-TV Servicing, Broadcasting and Communications or Industrial Electronics.



Electronic equipment is already being used to count, weigh, control flow of liquids, solids and gases. Inspect at remote points. Supervise traffic. Survey land and ocean areas. Search for oil miles beneath the surface. Translate one language into another. It is used in business to process data, control inventory, prepare payrolls. In medicine

Look at the classified section of your local newspaper. You'll see there are more job opportunities for

for diagnosis and electro-surgery. All of this equipment needs installation, needs servicing . . . needs men.

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Job counselors recommend investigating Electronics if you are not now content in your present job, if you are worried about your future. The few minutes it takes to mail the coupon below could be the most important few minutes in your life.



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SAGINAW, MICHIGAN



and the downward pull of its guy cables exert over two million pounds of pressure on the concrete base. The heavier of its 30-foot triangular sections weighs about 14,000 pounds. It is supported by 18 guy cables which, if stretched end to end, would reach five miles.

To facilitate painting and maintenance, the tower is equipped with a two-man elevator. Even so, it takes over 20 minutes to reach the observation platform near the top—the longest elevator ride aboveground in the world.

MRS. MILLIE RHYNE
Chamber of Commerce,
Cape Girardeau, Mo.

Built-In Bottle Opener

IN YOUR August "I'd Like to see them Make" there was a request for a refrigerator with a built-in bottle opener. If Mrs. Schouz will swap her refrigerator for a 1960 Philco, she'll find this wonderful feature.

S. COMINSKY, Philadelphia.

VW Man Yells No Fair

"HERE Come U. S. Minibuses" [Nov.] grossly misrepresented the Volkswagen station wagon. On the first page is pic-



tured a 1961 Chevrolet Greenbrier beside a 1958 (or older) VW. The Greenbrier costs hundreds of dollars more than the standard-model VW pictured.

In your chart, the Volkswagen engine is listed as having a horsepower rating of 36 at 3,700 r.p.m. In fact, the SAE rating is now 40 hp. at 3,900 r.p.m. And far from straining to reach the speed of 55 m.p.h. while the Chevrolet cruises easily at 60-65, the VW station wagons cruise at 59.

RICHARD L. MUGG
Inter-Continental Motors Corp.
San Antonio, Tex.

Tiny Balls for Bearings

WE NOTICED the photograph of the two tiny pivot bearings standing on the head of a pin ["How to Build an Automobile Smaller Than a Dot," Nov.]. Perhaps

CONTINUED

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ELECTRONICS

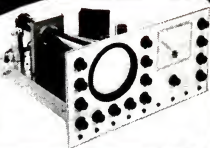
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Shown at right is the versatile . . . usable combination oscilloscope and voltmeter which DeVry Tech men build during the new Space and Missile Electronics program. New movies, new subjects, new texts, new experimental projects, all prepare you thoroughly, in this latest and greatest DeVry Tech training program. No advanced education, no previous technical experience is needed.



DeVry TECH PRESIDENT VISITS MISSILE FACILITIES

Mr. T. J. Laseber, President of DeVry Technical Institute, recently visited missile facilities and was impressed with the important part played by Electronics Technicians.

EXPLORER VII SATELLITE

Picture of the famous satellite. Remember, assembling and checking Electronic devices in satellites and missiles is only one of the exciting new jobs now open to trained technicians.



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Please give me your two free booklets, "Pocket Guide to Real Earnings" and "Electronics in Space Travel"; also include details on how to prepare for a career in Electronics. I am interested in the following opportunities (check one or more):

- ☐ Space & Missile Electronics ☐ Television and Radio ☐ Microwaves
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2077

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5 FABULOUS IMPORTS

YOU CAN BUY BELOW WHOLESALE PRICES!

UNUSUAL VALUE • TRANSISTOR RADIO your cost, JAPAN \$1.85

AN EXOTIC GIFT • 6 PIECE KNIFE SET your cost, INDIA \$3.65

WANTED NOVELTY • CROWN TABLE LIGHTER... your cost, JAPAN \$3.39

A FAST SELLER • BLACK FOREST CUCKOO CLOCK... your cost, GERMANY \$1.63

A BEAUTY • BEER STEIN ... your cost, GERMANY \$1.95

MAIL ORDER DISTRIBUTORS NEW HOME — IMPORT — MAIL ORDER PLAN ALLOWS YOU TO MAKE PROFITS UP TO 5 TIMES THE ORIGINAL COST OF HUNDREDS OF EXOTIC WORLD WIDE PREMIUM GIFTS IN YOUR OWN BUSINESS...

If you're like most people, you've always dreamed of "some day" starting and owning a nice little HOME IMPORT-MAIL ORDER BUSINESS so you can quit knocking yourself out day after day, with no real money to show for it. "What a relief!" "Just to pick up orders and money at the Post Office, with almost nothing to do but spend your profits!"

START NOW! NO EXPERIENCE NECESSARY! As you can see above, there are fantastic profits in IMPORTS! But what most people don't realize is that importing procedures are too complicated for the average person to undertake. Because Mail Order Distributors is already importing hundreds of fast-moving items from all over the world, you can do the same without previous importing knowledge!

NO INVESTMENT IN MERCHANDISE—IMPORT RICHES OVERNIGHT! Mail Order Distributors' plan is an airtight program, all laid out for you—ready to go! Available to you at once! You don't advertise! You don't invest in merchandise or inventory! You don't even handle imports that you sell so easily, by mail! About all you have to do is go to the Post Office for mail and bank your PROFITS!

EXCLUSIVE FRANCHISE IF YOU ACT NOW AND CAN QUALIFY Once you start making money in this exciting way, you'll want to make sure it will last... you'll be offered an opportunity to have an Exclusive Franchise to hold as long as you qualify. With this Franchise as protection you may make more and more and MORE!

NOTE: Only a limited number of Exclusive Franchises are available. Receive complete details about this fabulous Home Import-Mail Order Opportunity and 100's of "Below Wholesale" Imports without cost or obligation! Don't delay. Mail NOW...

Mail this Coupon for FREE DETAILS today!

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Mail to: MAIL ORDER DISTRIBUTORS, Dept. C-61
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you would be interested in the very tiny balls used in the bearing which is fitted into our EternaMatic watches. An average thimble will hold 21,000 of them. Each ball measures only 26/1,000 inch and weighs 1/28,349 ounce. They are so light they float on water.

G. GUGGENBUHL, Eterna Ltd.
Grenchen, Switzerland.

How to Raise Worms

LAST summer, a Southern letter writer sent in an S.O.S. to worm raisers. I've been checking into this fascinating subject and think I've come up with a solution for him.

First make a heap of peat moss in a sheltered area in the yard. In between



the peat moss put a few layers of burlap. (This is where the worms are supposed to lay their eggs.) Make sure there is enough drainage.

Mix into the moss a few handfuls of corn meal and coffee grounds, adding as necessary, and keep the moss moist. It will soon be crawling with worms.

GUS ULAHAKES, Union, N. J.

Early-Car Drivers Remember When

READING the letters about the Buckboard [Nov.], brought to mind a cycle car—as early midgets were called—that I owned. A "Woods Mobilette" with a 103-in. wheelbase and a 36-in. tread, it had a 4-cyl., 8-hp. engine; 2-speed forward and reverse. If you twisted off the rear-axle shaft, you could still drive with one wheel, as it had a special differential such as high-priced cars have today.

I was a rural mail carrier and I could go over bad roads because of that narrow track. I could have one wheel in the "good rut" and the other one clear of the "bad rut," changing as conditions demanded.

My first car—bought used in 1907—was a curved-dash Oldsmobile. It had a tiller steering handle and was chain-driven, as were two Reos I owned after

(Continued on page 27)

"I call it a bad day if I don't make \$25 before noon"

(This chair alone brought \$4.50 with twenty-five minutes work and 32¢ in cleaning materials.)

"Just a few months ago I made the big move. I gave up my job and started spending all my time in the little business I had been running on the side. It wasn't an easy decision, but, now I'm tickled to death I made it. Not just because I'm my own boss or because I have an excellent chance of making over \$10,000 this year. It goes deeper than that.

"You see, this idea has caught on like wildfire in my town. Not a day goes by without my phone ringing with women calling for appointments. The beauty of it is that once a woman becomes my customer, she calls back year after year. Not only that, she tells her friends, too, and they call me. Before I know it I'm swamped with work. (And at \$7.50 an hour net profit it doesn't take long before my bank account is really mushrooming.)

"Funny thing, but back last year, before I started, I never realized the money there was in this business waiting for someone to come along and collect it. Just think: every house in town has furniture and most have rugs or carpeting. I concentrate on just the better homes and have more work than I can handle. You know why? Because women are fussy about their furnishings. Can't stand to see them dirty. That's why they call me over every year.

"The average job is worth \$25.00 to me and takes a little over 2 hours. Out of this, after paying for materials, advertising and other expenses I net about \$15.00 clear profit. This means I need just 3 jobs a day to clear \$11,250.00 in a year. Frankly, since this will be my first full-time year I'll be glad to hit the \$10,000 mark. But after that this business should grow larger each year until I have to hire men to help me handle the business.

Personally Trained

"Believe me there's nothing magic about it. I didn't know a thing about cleaning home furnishings before I became a Duraclean dealer. But after my application was accepted, I was trained in their factory-training school and by a dealer in a nearby town. I was astonished by the short time it took me to become an expert. Actually, much of the credit must go to the Duraclean process, which is so safe it has earned the Parents' Magazine Seal.

"The portable machine you see is just one of the electrical machines I use. It manufactures a light aerated foam with a peculiar action chemists call 'peptizing'. It means that instead of being scrubbed deep into the fabric, dirt is gently ABSORBED by the foam, leaving the fabric clean all the way down. Women can't believe their eyes when they see how it works. Colors appear bright again, and rug pile unmat and rises like new. I don't have to soak rugs or upholstery to get them clean, which ends the problem of shrinkage, and means the furnishings can be used again the very same day. This alone has brought me a lot of customers.

"As a Duraclean dealer I make money with four other services, too: **Duraproof** . . . which makes furnishings immune to moth and carpet beetle damage (it's backed by a six year warranty). **Durashield**, a brand new dirt-delaying treatment. It coats fabrics in an invisible film that keeps dirt out. **Duraguard**, another new service, flameproofs draperies, upholstery and carpets to reduce charring

by
Harold Holmes



and the tendency of fires to flame up. And **Spotcraft**, which consists of special chemical products for removing stubborn spots and stains. On jobs where I perform all five services, I multiply profits!

"One of the nicest things about being a Duraclean dealer is that I get continuous help from Duraclean Headquarters. My services are nationally-advertised in famous magazines like McCall's, House Beautiful and many others. I also get a complete advertising kit prepared by experts. (There's even a musical commercial!) I get a monthly magazine full of methods to build business and I can meet with other dealers at Duraclean conventions. I'm also backed by insurance. In fact there are over 25 regular services I get under their unique System.

No Shop Needed

"Maybe you too would like to break away from your job and make a fresh start in a business of your own. Do you need a shop? Certainly not. I operate from home. Need a lot of money to start? Not at all. Duraclean finances reliable men, after a moderate down payment, and furnishes enough supplies to return your TOTAL investment.

"You get everything you need: equipment, supplies, advertising matter, personal training, and regular help from Headquarters. To get all the details, fill out the coupon. There's no obligation and you can decide for yourself. I'll say one thing: if you DO become a Duraclean dealer, you'll be glad the rest of your life that you took time today to write."

Irl H. Marshall, Jr., International Headquarters
Desk 1-181 839 Waukegan Avenue, Deerfield, Ill.

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Desk 1-181 839 Waukegan Avenue, Deerfield, Ill.

I'm interested in owning my own business. Please send illustrated booklets and full details FREE outlining the Duraclean Dealership Program and territory arrangement.

Name _____ Please print
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City _____ State _____

PS Puzzlers By Joan Steen

New Year's riddles for you to resolve . . . Answers on page 217



Case of the Mixed-Up Dancing Partners

THE New Year's Eve party at the country club this time was a formal dinner dance. Ed, Frank, George, and Harry, and their wives arranged to go together. Just short of Auld Lang Syne time, the group had been exchanging dances. Betty was dancing with Ed, Alice

with Carol's husband, Dorothy with Alice's husband, Frank with George's wife, and George with Ed's wife.

Now just resolve all these mixed-up pairs and tell who's married to whom and who's dancing with whom. And Happy New Year to you, too!

IN THAT strange way that letters have of crossing in the mail, several of you submitted this puzzle to me while others asked for its solution:

There are three houses facing three electric poles. Each pole must feed a wire to each of the three houses. None



of the wires can cross. How can you manage it?



A GAS-STATION owner, having a small number of cans of special oil left, bargain-priced them for quick sale. The first buyer took half the lot plus half a quart. The second took half the remaining oil plus half a quart. And the last buyer took half of what was left, plus half a quart, and that finished the supply. At no time did the dealer break a quart. How many quarts did he have at the start?

NEW HOME-BUSINESS offers beginners BIG PROFITS!

"I Earn \$25⁰⁰ per Hour" * Spray with Suede!

\$1 Worth of Materials Brings You \$18—You pocket the profits!

WHAT IS FLOK-KRAFT?

If you've ever touched real suede or velvet—you know how Flok-Kraft feels and looks. Now, at last this beautiful new 3-dimensional finish, developed after years of experience, can be sprayed on anything—transforming ordinary things into expensive masterpieces of beauty. You must see it to believe it, so mail coupon below and receive free samples.

Here is Mr. J. F. K. with a few of the items he has sprayed with Flok-Kraft. He is now earning \$25.00 per hour (\$400 for 16 hours work) just showing companies how to spray new Flok-Kraft.

your business grows, work full time—hire others to work for you. At first, do it all in your own home—a corner of your basement, garage, dining room, service porch or kitchen is all the space you need.

LEARN IN A FEW DAYS
Almost immediately you can learn Flok-Krafting and start earning money. It's fun, fascinating—we guide you with simple step-by-step instructions. No overhead, no expensive equipment, no experience necessary either.

JOIN THESE MEN AND WOMEN

who have already started. "Earning \$10,000 year from spare time start" **Mr. Hoyer, Ore.**; "Got \$52.50 doing auto trunks in four hours—earned \$13 per hour" **J. O., Mo.**; "Scumped with orders already" **W. F., Colo.**; "Got \$100 job first day" **C. H. E., Md.**; "Quick \$140 order from store—5 other orders in 4 hours" **H. G. R., Wis.**

FREE SAMPLES—MAIL COUPON NOW!



Make old (even broken) radio and TV cabinets look better than new. Spray average size cabinet in 15 minutes with 34¢ worth materials and charge at least \$10.00.

COVERS AND BEAUTIFIES FABRICS, METALS, GLASS, PLASTER, WOOD, PLASTIC—any surface! Huge profits are waiting to be tapped in this tremendous new field. Over 5,000 big profit uses. Spray lamps, figurines, greeting cards, signs, automobile accessories, shoes, hats, card tables, toys, furniture, draperies, ceilings, walls—anything! Flok-Kraft makes old, damaged and worn objects beautiful and saleable—makes new things worth more. You can even spray cheap butcher paper and make it look like velvet-suede, and sell it for gift-wrapping paper.



400¢ profit possible just spraying figurines, toys—hundreds of other items with beautiful Flok-Kraft. Work at home—spare time!

WE FURNISH EVERYTHING YOU NEED

We offer to furnish you complete easy-to-understand instructions in addition to materials that enable you to start at once. All sent at our risk because we want to start new Flok-Krafters in every area.

HELP FILL HUGE GROWING DEMAND

Imagine, there is a possible 20 Million Dollars worth of Flok-Krafting to be done. Get your share! Be first in your area to fill urgent orders that come from stores, offices, homes, neighbors, gift shops, architects, auto dealers, etc. Learn how to get orders by mail order.



\$1000.00's are earned by individuals each year spraying Christmas trees with colorful Flok-Kraft! Flok-Krafted greeting cards are big business. Buy regular cards and spray them at home—sell for twice your price.

ALL 3 FREE!

Just mail coupon below and receive **ACTUAL USE-ABLE SAMPLES, BOOKLET OF 50 HOME-BUSINESS OPPORTUNITIES AND CONFIDENTIAL DETAILS**—all sent free!

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Recondition worn automobile interiors (doors, trunks, dashboards, seats, etc.) with Flok-Kraft. Just spray it on—works like magic!

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Amazing Flok-Kraft rayon and cotton fibers are now available in over 24 brilliant colors—even the amazing fluorescent "glow" colors that attract attention.

START AT HOME—SPARE TIME

Here's a rare opportunity to own your own business. Start small spare time—add to your present income. Then, as

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I am interested. I enclose no money. Rush Free Samples, Home-Business booklet and confidential details. I understand these are all sent absolutely free and no salesman will call.

Name Age

Address

City Zone State

Our references: your local bank & trust Co. We are members of the Los Angeles Chamber of Commerce.

PS Puzzlers continued

HERE are some "think fast" ones for you:

1) A ship is anchored in a harbor. Over its side hangs a rope ladder containing 40 rungs spaced 14 inches apart. Exactly 13 rungs are above the water at low tide. If the tide comes in and raises the water level six feet, how many rungs will then be above water?

2) Name three positive integers that add and multiply to the same total.

3) If five boys can pack five boxes in five minutes, how many are needed to pack 50 boxes in 50 minutes?



Puzzle of the month



AS A puzzle editor, I confess there's one type I've been avoiding. That's the Train, or How-Many-Eastbound-Freights-Do-You-Pass, puzzle. The reason's obvious. I usually slink off in defeat. High time I tried again. Hence this specimen from Lewis Carroll:

The setting is the Charing Cross Station in London. Clara's aunt is saying, "The Bayswater and Birmingham Extension is just completed, and the trains now run round and round continuously—skirting the border of Wales, just touching at York, and by

the east coast back to London. The westerly ones go round in two hours; the easterly ones take three; but they always manage to start two trains from here, opposite ways, every quarter of an hour."

Clara and her aunt agree to board opposite-bound trains at the same time and see who can meet the most trains. "Remember," the aunt says, "we can only count the trains met *on the way*. You mustn't count the one that starts when you start or arrives as you arrive." (Answer next month.)

Answer to last month's P.O.T.M: The Josephus problem described 41 people arranged in a ring and bent on self-destruction. The order of death was to be determined by counting off in thirds. Where should Josephus and a friend stand to avoid untimely ends? This is easy to do simply by arranging 41 points in a circle and striking out every third. The next to last position is 16, the last 31.

The British scientist P. G. Tait worked out a general rule for this in 1900. Restricting himself to one survivor only he noticed that if the total in the Josephus case (41) was upped by 1, the last man's position (31) was upped by 3—significantly the counting-off number.

Tait then went on from there to prove this rule: If n people are arranged in a

ring, and p is the last man's place when counting every m th person, then for the case $n + 1$, the last man's place is $(p + m)$. If $p + m$ is greater than $n + 1$, the last man's place moves down to the beginning of the ring: $(p + m - n - 1)$.

To make a table that would extend the Josephus problem to large numbers, Tait solved this formula for x :

$$p + 3x - (n + x) = 1 \text{ or } 2.$$

This would tell him when he got to the end of one cycle and p had to jump back to the beginning of the ring. Thus for $p = 31$, $n = 41$ the value $x = 6$ is found. So, when $n = 47$, the last man's place is 2. In this way Tait could say, practically at the drop of a hat, that in a ring of 1,000 persons, he-who-would-be-last had better stand in the 604th place.

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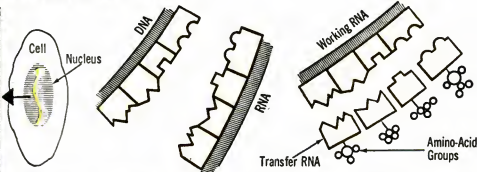
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The month in science

Living things made to order. Biologists are now zeroing in on one of the most remarkable feats ever dreamed of. By shuffling the basic chemicals of life, they should soon be able to manufacture simple plants and animals to planned designs. They could create new kinds of living things the way metallurgists now create new steels.

The first experiments hinting at such a fantastic future have already been performed. A team at Harvard has "unzipped" chemicals that mastermind the growth of bacteria, then put

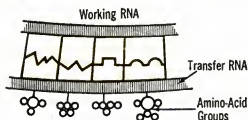
How DNA makes us what we are



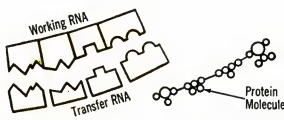
1. Long spiral molecules shown in electron microscope view are DNA. It directs growth from nucleus of every cell in all living things.

2. DNA molecule is a master template. RNA molecule assembles next to it, duplicating DNA's form to make working template.

3. Working-template RNA shapes formation of transfer RNA. Each section of transfer RNA carries its own type of amino acid.



4. Amino acids line up as transfer RNA fits itself to the working RNA. Once lined up properly, the amino acids link themselves together into protein.



5. Newly made protein molecule, assembled according to pattern specified by DNA code, leaves transfer RNA to go to work as part of a living cell.

them back together so that they worked as before. Not only that, but the scientists were able to reassemble the parts in different forms, to make new bacteria. This is crossbreeding, but many levels beyond the art practiced by farmers. It crosses not the plants or animals, but the chemicals that make up their cells.

The Harvardmen's achievement caps discoveries of the past decade that have stripped away much of the mystery surrounding life. Why does one cell multiply uncountably to become a tree, while another becomes a man? In the beginning the cells are remarkably alike, yet the results are extraordinarily different. Inside the original cell must be a master control that dictates all subsequent growth.

The astonishing thing is this: The master control is the same

The month in science continued

chemical in all living things. It differs only subtly between men and trees. Yet this tiny difference makes men men and trees trees.

This universal control chemical is a tightly coiled, long molecule called DNA (for deoxyribonucleic acid). It has two spiraling strands—each composed of phosphate alternating with deoxy-ribose sugar groups. These strands are linked by “base” groups—adenine, guanine, cytosine, and thymine. All DNA is made that way. The difference that accounts for the great variety of life on earth is the *order* in which the four bases are strung on their supporting strands. This variation in sequence is the code of instructions for the manufacture of body parts. One section of DNA with a particular sequence of bases settles the color of a baby's hair, another section shapes its hands.

Complicated things call for more instructions. So the DNA molecule is longer in the higher animals than in the simplest plants. The smallest virus (called X174), which was strained out of the Paris sewer, has 6,000 bases in its DNA. Human DNA contains *billions* of bases. When a baby starts life as a fertilized egg—too small to be seen with the naked eye—it possesses 1/5 of a millionth of a millionth of an ounce of growth-directing DNA. This potent speck is so coiled up that if you could unkink it, you would have a chain three feet long. A full-grown adult's DNA, if uncoiled, would stretch out five billion miles!

Scientists aren't so sure about the way DNA does its job. Best guess: The operation is like a machine shop. Apparently the DNA in every living cell is a master template. Cell substances fit themselves to it, forming a working template that is similar in shape but slightly different chemically. This is RNA (for ribonucleic acid). Now the RNA working templates fashion a second type of RNA—transfer RNA—that carries building-block chemicals into line. Once lined up, the building-block chemicals join into molecules for muscles, nerves, or whatever called for by the instructions of the master-template DNA.

The Harvard scientists unzipped the spiral DNA molecules and reassembled them into new combinations. Eventually scientists may be able to make DNA synthetically, from the ground up. New master templates would produce new kinds of living things—better foods, flowers, cattle, or creations unimaginable now. In medicine, defective DNA templates—already known to cause some diseases—might be replaced by good ones. Perhaps what we call old age creeps up as DNA master templates blur their original patterns. If so, an infusion of fresh DNA could be the Fountain of Youth.

You can't win 'em all. When Bulova announced its \$175-up, tickless, superaccurate wrist watch [PS, Dec. 1960], the press agents made much of the fact that its electronic timekeeping mechanism had been installed in the Explorer VII satellite. Purpose: After exactly one year, it was to turn off Explorer's radio transmitters. (Scientists worry about cluttering the radio bands with satellites that never shut up.) The year ended recently. And Explorer is still talking. It wasn't the timekeeper's fault (apparently a switch stuck), but it did kill that advertising campaign.

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**FREE
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[Continued from page 14]

that. All three were one-lungers, with kerosene lamps, and no windshields or tops.

NIC. KLEIN, Waterloo, Iowa.

... WE BOUGHT our first car in 1901. It was a Locomobile Steamer and we stored it in a public livery stable. When we wanted to use it, we pushed it out onto the street. We then put a handful of cotton waste saturated with gasoline in the gutter, placed the "torch" (a piece of iron bent in a V about 14 inches long) over the waste—one end on the curb and the other in the street. The waste was lit and in about 10 minutes the torch was hot. We picked it up with blacksmith tongs, inserted it in a hole under the boiler, and turned on the gasoline. In a half-hour we had sufficient steam pressure to get in the car and go for a 20-mile drive.

It was not until 1904 that we were required to get a license (in Philadelphia). We went to the boiler-inspection department for the license certificate. It had a red number in an upper corner. At a hardware store we bought numbers to correspond, nailed them on a piece of wood and hung same on the back of the car. Gasoline was eight cents a gallon and no tax.

L. C. HUMPHRIES, St. Petersburg, Fla.

The Long Way 'Round

IN AUGUST PS, you used an idea I sent in (and was paid for) in "Hints from the Model Garage." It told how to remove paint scuffs from car bumpers. As is typical of this page, my name was not used.

Recently my brother, who lives in San Diego, visited me and we were discussing PS. Imagine my amusement when he told me at some length about a dandy little hint he'd found for cleaning bumpers, and how successfully he'd used it.

C. H. HARDY, Whittier, Calif.

He's Against Propping Pisa

TELL that Reno, Nev., resident ["PS Readers Talk Back," Nov.] he'd better stick to the slot machines and not add to the worries of the Government Com-



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mission for Vigilance for the Stability of the Bell Tower of Pisa.

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Let the thing fall; look at all the work it'll create.

KEN PATROS, LaCrosse, Wis.

Building a \$20 Dinghy

I PUT together your \$20 dinghy [July] and I'd like to suggest to other readers planning to build it that it might be worth the time and money to add a few more inches of freeboard. I've been swamped



once. Still, it has been a wonderful dinghy for our boat and we've had a lot of fun in it.

D. JOHNSTON, Grosse Pte. Park, Mich.

Hoist by Our Own Petard?

MAY I take a pot shot at Paul Kearney ["A Safety Expert Rates the 1961 Cars," Oct.]? He says: "The most dangerous type of car built, the convertible, is enjoying its highest ratio of sales in history." Fast selling, yes; but the convertible isn't any more dangerous than the thin-topped things called hardtops. Furthermore, they have stronger frames than those used in other cars.

Any hesitant buyer should check his back issues ["I Say Convertibles Make Sense," Apr. '59]. Writer Hubert Luckett states: "A canvass of the major safety agencies and insurance companies failed to turn up any evidence that convertibles are any more dangerous than any other car."

ROGER SCHLEGEL, Eau Claire, Wis.

Rustproof Shutter Latches

I HAVE the answer for the man who wants ornamental shutter latches made of plastic ["I'd Like to See Them Make," Oct.]: They'd never stand up. What he should get are aluminum ones, painted black. These cost about \$1 a pair and look exactly like wrought iron, but are completely rustproof. I bought mine in a local hardware store.

FRANK H. FRENCH, Baltimore.

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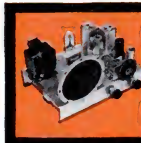
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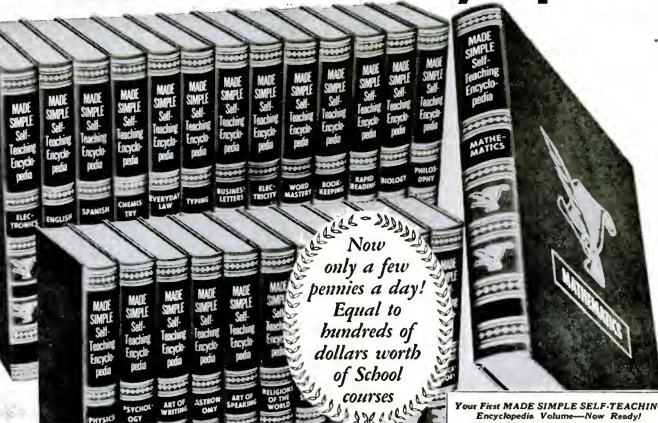
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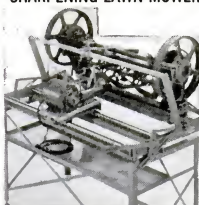
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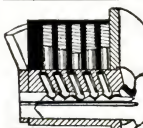
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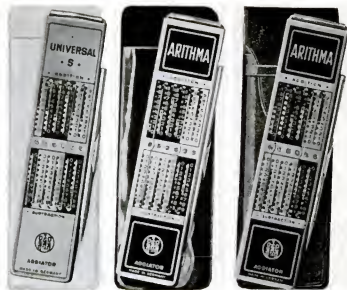
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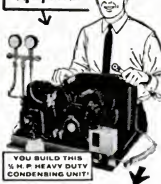
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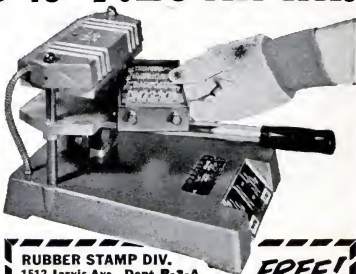
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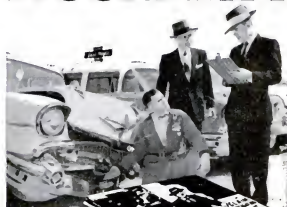
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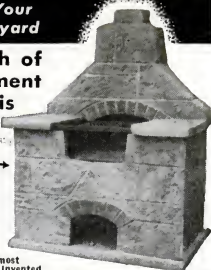
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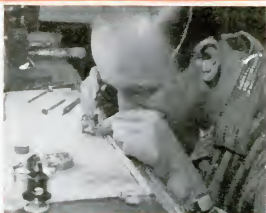
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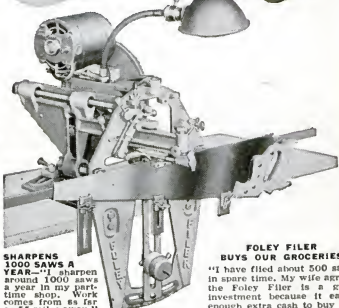
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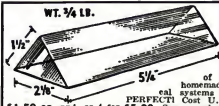
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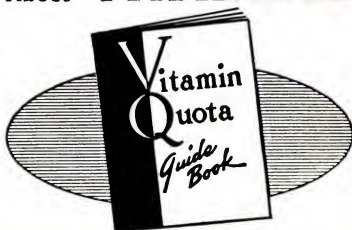
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A PRIME factor in optimistic auto-sales forecasts for the coming years is the huge road-building program now under way throughout the nation. "You can't sell cars unless your customers have someplace to drive 'em," is the way one

auto-company sales executive put it.

And after some 5,000 miles behind the wheel of test cars in recent weeks, I'm satisfied that new road construction makes those sales forecasts for the current decade—7½ or 8 million cars a year—look good. Limited-access highways are spreading like crab grass over the country. They change the entire concept of travel, cutting the time it takes you to get to point B from point A by as much as 50 percent.

Ohio, Michigan, Illinois, and Wisconsin seem to be doing an especially good job. I can personally verify that in many cases in those states it's now possible to make trips that used to take 12 hours in as few as eight hours—without exceeding posted speed limits. And you feel much safer all the time.

No wonder automobile men are rubbing their hands in happy anticipation.

The trouble with back-seat TV.

Dream-car doodlers love to put television sets into their imaginary automobiles, but engineers haven't found a practical way of putting them in production models—yet. Two promising developments: new circuitry that combines the jobs of several vacuum tubes in one compact unit; the gradual reduction in transistor

prices. These help with two headaches: price and size.

Others remain. You can't mount a towering antenna on a car to insure a good picture in poor reception areas. And a TV set's delicate innards object to the jostling they get in a car.

When will car TV be available? Estimates range from two to five years.

New haulways pamper cars.

A dual-purpose, enclosed trailer may save money indirectly for new-car buyers. Made by Dual-Evans Corp., it will protect cars from damage by weather, vandalism, and pilferage.

Cars shipped on conventional, skeleton-type haulways often arrive with paint pitted by sand or hail. Small boys

with slingshots and rifles break windows and puncture tires. Thieves steal tires, wheels, and accessories. This increases insurance, boosts dealer make-ready costs—and, ultimately, raises the price of cars.

Also, the new enclosed vans convert in minutes so that they can haul other kinds of freight after the four cars they carry (five, if compacts) are unloaded.

New engines coming up. Trade sources report an unusual amount of activity in engine and drive-line tooling for 1962 models. Chrysler, Ford, and

General Motors all have placed big orders for new equipment. Chrysler plans to market an improved, lighter transmission. There is also a possibility that the



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PERFECT BALANCE

DETROIT REPORT continued

company will switch to aluminum blocks exclusively for '62 slant-six engines.

Ford is less intrigued with aluminum for engines, but might make transmission news in '62—and will have ready by then its inexpensive, no-lash valve gear, which does away with cranky hydraulic lifters.

GM will offer more transaxle arrangements, like those in the Chevy Corvair

and Pontiac Tempest. And at least two more aluminum V-8 engine blocks are likely to be in GM cars next fall. One may go under the hood of the 1962 Chevrolet. Cadillac is also a prime candidate for a new engine; the current V-8 has been updated periodically, but still goes back to the basic OHV V-8 introduced nearly 10 years ago.

Production storms at Tempest.

Competitors report that Pontiac had problems in building its first Tempests. Source of trouble—the bowed drive shaft. Quality inspectors rejected many of them for minute surface scratches; “they might fatigue and fail in service,” was the word.

And Pontiac was determined not to repeat the kind of bad time Chevy went through last year when it first introduced the Corvair. Result: Production went slower than anticipated, but Pontiac figures it scotched many potential buyer complaints.

No more red lights? A “traffic-pacer” lighting system is being installed on a four-mile stretch of road near Detroit. The new system uses lighted speed signs, which are synchronized with traffic lights. The signs show motorists the speed they must maintain to make a green light at the next signal.

The system is expected to increase the capacity of each lane by 20 percent by

maintaining an even traffic flow and eliminating the red-light “lag time” as long strings of cars get slowly under way. Simple in principle, the advisory speed signs—spaced at 1,000-foot intervals—work something like the flashing “don’t walk” signs for pedestrians. General Motors Research Laboratories is installing the \$140,000 system in cooperation with local road authorities.

Testing iron’s mettle. Iron and steel, traditionally the most important materials in automobiles, continue to predominate in '61 cars—but they’re facing tough competition. Aluminum has its foot further into factory doors with a rash of new engine blocks, transmission castings, and other parts. Plastics also show gains. Plymouth’s Valiant has a “Delrin” acetal-plastic instrument-panel housing.

Magnesium looms as another interloper. Price of this very light, strong metal has dropped, stepping up research into more potential auto applications. Volkswagen uses some 90 tons per day. One engineer reports that it could be used in place of aluminum, except for exterior trim. He believes it has an especially big future in valve trains, where strength and light weight are musts.

Two-ply tires for compacts? All major tire companies are taking a look at the possibility of using light, two-ply tires on tomorrow’s cars in place of the heavier four-plys.

Lighter tires would reduce unsprung weight, easing suspension problems in smaller cars. Two-ply tires run cooler than four- or six-ply tires. They would be slightly less expensive than the standard

four-ply tires you have on your car now.

One tire man says his company got interested in two-ply tires as a result of an abortive “emergency-spare” development program. The idea of making a lightweight, easily stored spare for emergencies never got off the ground, but several two-ply experimental tires tested out so well in the laboratory that research continued.



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The solid chrome on Perfect Circle 2-in-1 rings is 25 times thicker than the chrome plating on an automobile bumper.

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CHANGE TO LUCKIES
and get some taste for a change!

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MEANS FINE TOBACCO

**This is the story
of what is probably the
biggest fraud in America.
You yourself may have
been, or will be, the
victim of it**

Can We Stamp Out Speedometer-Rigging?

By E. D. Fales Jr.



IN A used-car showroom in a small Eastern city, as this is written, stand two automobiles. One is a 1956 Plymouth with an odometer reading of 38,000 miles. The other is a 1959 Mercury with an odometer reading of 70,000 miles.

The mileage on the Plymouth is faked. The mileage on the Mercury is honest.

"We took in the Plymouth two days ago," the dealer told me. "With that 'low' mileage someone will grab it fast. But the Mercury has stood there for two months with no takers.

"Yet the Plymouth actually had more miles on it than the Merc. One of these days we'll give the Merc the same phony treatment. Then watch somebody snap it up."

To see how prevalent such fraudulent practices are, I set out recently

Walk on to practically any used-car lot in



'53 Olds showed 64,195.8 miles
Dealer estimate: over 150,000



Dealer comment: "A flagrant case of odometer set-back. Notice the numbers out of line. The car has been around, and it's been abused."



'50 Pontiac showed 85,868.5
Dealer estimate: some 200,000



Dealer comment: "This isn't the first time we've had this car. The last time we sold it, we ourselves took off 20,000 miles."



'56 Ford Victoria: 26,250.7
Dealer estimate: 65,000



Dealer comment: "We've set this car back twice ourselves. But it has been given good care and is in good mechanical condition."

to talk with dealers, mechanics, state officials, and ordinary motorists who buy used cars. I saw scores of cars with odometers—that's the correct name for the mileage meters, although most people refer to them as speedometers—set back 10,000 to 40,000 miles.

On the basis of what I learned, it is safe to say that of the 12 million used cars sold in the U. S. each year, 80 to 90

percent have had their odometers altered. Dealers aren't the only culprits. Car owners do it themselves.

This article will tell you:

- Why the practice is so widespread.
- How odometers are doctored.
- What states have laws forbidding it.
- How you can protect yourself from odometer swindles on used-car lots.

Setting back an odometer is far more

the U. S., and here's what you will find



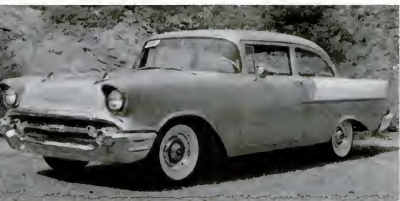
'55 Ford Fairlane: 41,079.0
Dealer estimate: 70,000

Dealer comment: "This is still a good car. We know the former owner. It cost us very little to put it in shape—about \$70."



'54 Mercury: 64,964.1
Dealer estimate: 64,964.1

Dealer comment: "That's true mileage. We asked \$375 for this car, and couldn't get it. So we'll turn her back to 30,000, ask \$575, get \$550."



'57 Chevrolet: 26,364.1
Dealer estimate: 40,000

Dealer comment: "We know this car has been turned back. The dealer we bought it from didn't even put the screws back in the speedo unit."



serious than merely cheating you out of money. A car with 40,000 miles in the little window on the speedometer face, but with 80,000 actual miles, can be dangerous. The shocks probably are shot, affecting control. Steering mechanisms may be badly worn. Brakes and hydraulic system may be faulty. Worn tires—probably a third set by now—may have had new treads cut in them, inviting

blowouts for the unsuspecting buyer.

The odometer of a used car may be set back as many as three times in the course of a single resale. The original owner fakes the mileage before trade-in. The dealer who takes the car in trade fakes it again. Another dealer or used-car lot buying the car for resale fakes it a third time.

Most cars have from three to eight



Can You Avoid Being Taken by Phony Mileages? Follow These Nine Rules

1. When buying a new car, ask the dealer, "Is this the correct mileage? If so, put it on the bill of sale." An honest dealer will oblige. Beware of one who won't.

2. When buying a used car, examine the odometer closely. It's almost impossible for a mechanic to get changed numbers back in perfect alignment after he has jiggered the recording disks.

3. Look behind the panel with a flashlight. An undisturbed odometer unit should wear a coat of dust. Look for finger marks and grease smears. Feel the attaching screws (as dealers do) for ragged slots indicating that they have been turned; check for screws left out altogether.

4. Examine the brake pedal. Heavy wear shows up at 20,000. New covering is a tip-off. Look for wear on accelerator, armrest, and driver's floor mat. Study the upholstery. Seat covers may have kept it fresh, but sag shows up after 40,000. Naturally, look for exhaust smoke which often shows up at 60,000. If the dealer has put in extra-heavy oil to avoid the smoke, a look at the dip stick will show it.

5. Take a mechanic with you—pay him—to examine the car. Many reputable dealers welcome this.

6. Search for forgotten clues—grease- or oil-change stickers, oil-filter tags, or antifreeze tags that may reveal the real mileage. Door jams are favored by servicemen for stickers of this kind.

7. Get the car's history. A reputable dealer will give you names of former owners. Some states keep a record as far back as three previous owners. A telephone call to the man or men who drove the car can be educational. Occupation is often a tip-off on mileage.

8. Pay \$5 for a title search. This will turn up the former owners.

9. Buy from a reputable dealer in your home community. He has a standing to maintain.

Were you cheated? If so, you have more than one court of last resort. Ask help of your motor-vehicle bureau, dealer-licensing board, Better Business Bureau, and your district attorney.

Don't hesitate to make complaints if you can back them up. "If more people would do this," commented one prosecutor, "we could stamp out this racket."

owners before they are junked, records show. So it is possible for a car to have had its odometer set back 24 times between birth and graveyard.

I found that dealers were honest about their dishonesty. Most of those I talked with cheerfully admitted jiggering their used-car odometers. On a tour of one lot, the dealer pointed out which cars his mechanics had "dixied," as he put it. The count: eight out of ten.

In one town I saw an order from a sales manager to his serviceman regarding an 18,000-mile Lincoln. It specified: "Repair odometer to 2,600."

Specialists in fraud. I learned that there are itinerant odometer experts, reputed to earn \$1,000 a month working from lot to lot. Sometimes they are followed by tire recutters who come with tools for knifing treads into shoes that have worn bald.

Not all such specialists charge fancy prices. In one town, a dealer directed me to a dingy shop at the end of a dark alley.

"This is one of four places in town that keep busy turning back odometers for dealers—and private owners," he told me.

I drove up the alley. My own odometer read exactly 59,108 miles.

"I'm getting ready to trade my car in," I told the lean, grease-smearing man who responded to my call. "Can you turn back the odometer, and what's the price?"

"Three-fifty," he said. "Takes an hour." "What do you think we should make it read?"

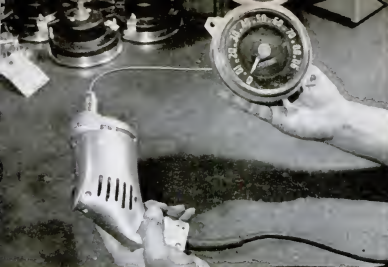
He sized up the car critically. "Wa-al," he said, "I reckon 32,108 would be about right."

The true mileage on my car was closer to 75,000 than 59,000. The meter had broken down twice, and I hadn't bothered to get it fixed.

The why of odometer-doctoring is simple: High-mileage cars don't sell.

Do buyers insist on being cheated? In one town I found a dealer who had taken a three-year-old Chevy station wagon in trade. He put a \$1,500 price tag on it, and found a customer—or so he thought. The customer backed out when he read 63,205 miles on the odometer. The dealer wasted no more time. He wholesaled the car at a cut price to another dealer 10 miles away.

[Continued on page 214]



These are two common ways of setting back an odometer

USING POWER DRILL is hard way to jigger odometer. With cable end in the chuck, drill's clockwise rotation reverses gears. A 3,500-r.p.m. motor rolls back the figures at 210 m.p.h.

EASIEST WAY, MANUALLY, is to tap end of odometer shaft with hammer. Bushing on tenth-mile disk is removed. Tapping disengages gears and a twirl brings up the desired numbers.



These two devices stop an odometer or reverse it

CUTTING OFF REGISTER of odometer is another trick. Here a gadget (left) is screwed to back of odometer. Index finger is on a lever that, when thrown, disengages cable to gears.

A REVERSING GEAR is sometimes interposed between cable output and odometer, causing the instrument to run backward. Control button in the foreground turns it on and off.

The Odometer May Be Cockeyed to Start with

While used-car hucksters are busily running mileage back, auto manufacturers are turning out sloppy odometers that pile on mileage. The error may reach 10 percent—and can cost you money.

POPULAR SCIENCE learned of one incident from a long-time reader who flew west for a vacation last summer. There he racked up 1,700 miles in rented '60 Fords. One day, checking the odometer against mileposts, he found that (1) the odometer read very high, and (2) he was going to be charged for miles he never drove.

A complaint brought a refund and an apologetic letter: "We have experienced considerable difficulty on some 1960 models—the result of the factory using an 18-tooth gear instead of a 19-tooth gear."

Checking in Detroit, PS found the trou-

ble limited to recent models, but not just Fords. There is now great variety in rear-axle ratios and tire sizes. Both affect wheel revolutions per mile and must be matched to odometer gear ratios. This leads to compromises and multiplies the chances of installing the wrong odometer gears. On top of that, auto makers are under so much pressure for fuel economy that they make sure any error favors high mileage.

A 10-percent-high reading hurts.

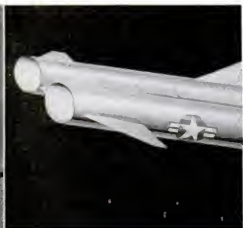
- When you trade in after a few years, the clock will show thousands of purely imaginary miles.

- You'll get 10 percent fewer m.p.g. than you think you're getting.

- If you rent such a car, you may be overcharged \$2 on a 200-mile trip, an increase of a full cent a mile.



First stage: VTOL fighter-bomber, 1,500 m.p.h.



Second stage: nuclear ramjet,

Next four generations of aircraft

The ultimate airplane—as far as man can go in design before rockets take over—would attain a speed of 17,000 m.p.h., 25 times that of sound, according to Alexander Kartveli, Russian-born vice-president for research and development at Republic Aircraft Corp. It would be capable of orbiting the earth at 200,000 feet and landing when it wished. There may be three stages of development preceding it, each ordinarily taking about 10 years to perfect.

Kartveli, who designed the first fighter to fly at 300 m.p.h. and the present 1,400-m.p.h. F-105 Thunderchief, proposes that all four stages be put on the drawing boards at the same time. This

telescoping would give the U.S.—by 1970 instead of the year 2000—these four generations of planes:

1. A 1,500-m.p.h. fighter-bomber that would take off vertically and pinpoint a target from an altitude of 75,000 feet.
2. A nuclear-powered ramjet strategic bomber capable of cruising at 2,800 m.p.h. 85,000 feet up, and with a 7,500-mile range to obviate overseas bases.
3. A 120,000-foot-altitude bomber that would cruise at 4,960 m.p.h. on two ramjet and two turbojet engines.
4. An eight-engine “lifting machine”—the ultimate—with a chemical air-breathing power plant. It would be able to reach orbiting speed, and to return.



It can be used as a warm sleeping bag . . .

For survival in the Arctic

This combination sleeping bag, overcoat, boots, and mittens can be vacuum-packed in a box 5 by 7 by 10 inches in size or stuffed by hand into the small carrying sack in the photo at right. The fabric is lightweight nylon insulated with easily compressible goose down.

Gerry, Inc., Boulder, Colo., designed the outfit for the Air Force. It may soon be stored in jet escape capsules for the warmth of flyers forced down in sub-zero weather.



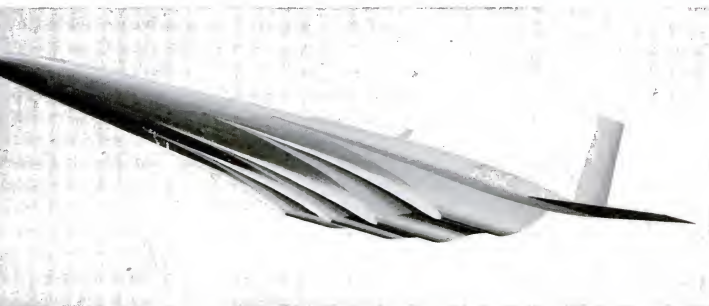
. . . or for hiking in bitter cold.



2,800 m.p.h.



Third stage: four-jet triangle, 4,960 m.p.h.



Fourth stage: earth-orbiter, 17,000 m.p.h. After it would come space ships and satellites.

Home-built Rolls-Royce

The only thing the Rolls-Royce factory would recognize in this car is the engine.

It's a huge 7.5-liter Rolls used in a London fire truck during the World War II blitz.

Headlamp cowlings are starter-motor housings from a German jet; the magneto is the kind on British Spitfires and Hurricanes; outside door handles are "flying wires" from a Virginia biplane bomber; inside they are throttle levers from a Lancaster. The frame and body were made from unused structural aircraft materials left from the



war. The car was built by RAF Flight Cmdr. Kenneth Wallis, is now owned by M. L. Cohn of Beverly Hills, Calif.



Our Secret Radar

By Martin Mann

LAST July 1 Russian fighters blasted a U. S. Air Force RB-47 into the Barents Sea. Two months earlier, rockets got Francis Powers' gliderlike U-2 over Sverdlovsk.

These are the recent casualties in one of the strangest wars ever fought: the Great Battle of Radar. At stake is the world.

We're scouting the Russians' electronics, listening to, analyzing, recording their signals. This tells what they've got

and how we can beat it. We must be able to put our bombers and missiles past their electronically controlled defenses. We must be able to block their attackers with our defenses. Our lives depend on it. And the Russians are scouting our electronics in the same way, for the same reasons.

The Radar Battle is a hot war: 10 of our planes shot down, 75 men killed. Yet usually the weapons are innocent black boxes—and sharp wits.

It is a most secret war; only the occasional shooting scrapes make the head-



SNOOPER SHIPS—commercial vessels fitted out with gear for electronic spying—are a favorite tactic of Russians. U.S. Navy planes snapped this "merchantman" 70 miles off our Midway base. Notice the cluster of enclosed antennas forward of the bridge; the big, high, open antenna aft of the bridge. There is a helicopter landing pad near the stern.

PS Exclusive: The grim story behind the U-2 incident and the worldwide electronic-spy battle we're waging with the USSR



War with Russia

lines. Military men clam up when asked about it. A lanky young Air Force major who reluctantly admitted an active role would not reveal his squadron number. It is forbidden to identify the units. Yet persistent legwork uncovers remarkably frank and detailed accounts of what is going on. Here is the exclusive story POPULAR SCIENCE has pieced together, a thrilling chapter in an epic struggle.

Ferrets and ravens. The U. S. patrols the borders of the Communist world with "ferret" airplanes: six-jet, 625-m.p.h. RB-47s and Navy P2V Neptunes. Until

Powers' mishap last spring, high-altitude U-2s ferreted across Communist territory.

The Russians probe our northern defenses—Alaska, Canada, Greenland—with their ferret aircraft (possibly twin-jet Il-28 Beagles). They also send subs and thinly disguised fishing trawlers cruising along our coast. The ships anchor near oceanside resorts where the electronic fishing is good: Fort Monmouth, N. J. (Army research center), Wallops Island, Va. (Space Administration test site), Cape Canaveral, Fla. (rocket base).

Flying in the ferrets are "ravens"—

DECOY MISSILE—the Quail (lower right)—is launched from a B-52 bomb bay to deceive antiaircraft radar. Quail's angular shape (particularly right-angling tail surfaces) reflects radar waves very strongly. On a radar scope, small Quail seems to be a full-size bomber. It wouldn't fool infrared systems so easily, since its engine throws off less heat than a B-52's.



How we listen in on Russian radar

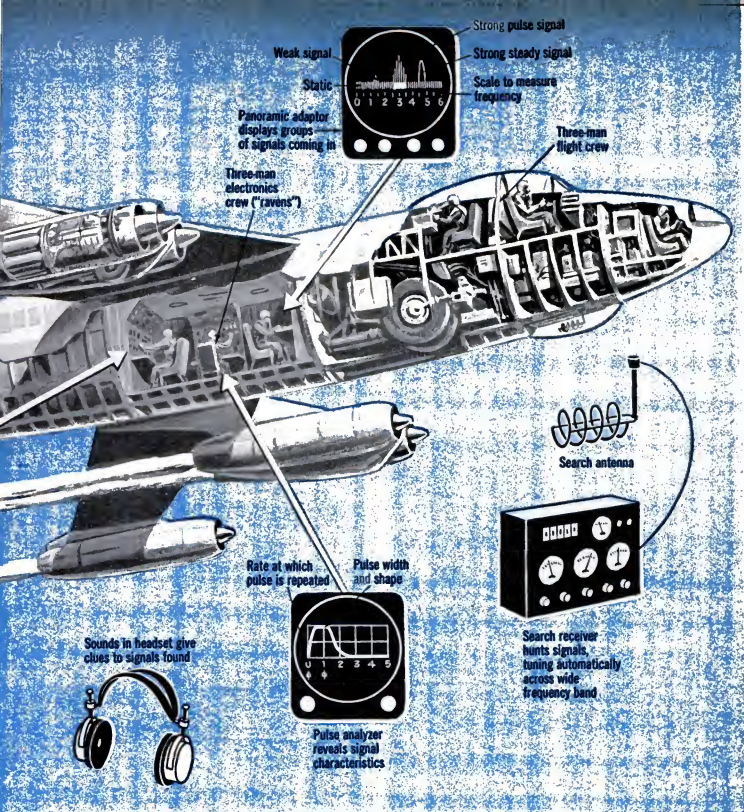


electronic-warfare specialists trained to pick up and analyze the other side's signals. Exactly what they do is secret—so secret that manufacturers in this country have actually had to set up private spy networks to find out enough to build equipment. Yet this much is known:

The principal tool is an extremely sensitive radio receiver that automatically tunes across a wide range of radar frequencies, hunting for stations like a signal-seeking auto radio. Its main amplifier is a traveling-wave tube, or possibly the ultimate in static-free devices, a maser.

The raven listens. Different radars sound different. A search radar makes a low-pitched *br-r-r-p* a few times a minute as its antenna regularly scans past the ferret plane. A height-finder goes *blip-blip*, pause, *blip-blip* as its beam nods up and down across the ferret. A precision radar beam fingers around the ferret, then locks on with a medium-pitched *br-r-r*. (Ravens are warned not to dilly-dally over identification of precision radar; it usually aims weapons.)

The raven tape-records the sounds for study. Several oscilloscopes help analyze



the signals and point to their source.

Easy mark. A radar station sends out a very powerful beam and registers the echo reflected back by an object. A ferret can pick up the transmitted beam much farther away than the radar can detect the echo reflected by the ferret. The raven can eavesdrop without giving himself away.

Radar and radio signals travel at least to the horizon. The higher up you are, the farther it is to the horizon. From even such an aging workhorse as the RB-47, which cruises at 40,000 feet, the

horizon stretches 200 miles away. So it can fly safely *outside* the Iron Curtain and still sample radars as far as 200 miles *inside* the Curtain.

Live bait. Of course nobody leaves all his radars turned on all the time. Why show your cards? So the ferrets bait the radar operators—deliberately fly close in the hope that more radars will go on.

Radarmen no longer fall for that as easily as they did. During World War II, the Allies once plotted a bombing raid to cross two radar lines in Italy. One was

[\[Continued on page 225\]](#)



Feed bag for oxygen

Horses suffering from respiratory ailments breathe easier when wearing this new plastic mask. It's held on by an elastic slipped over the horse's nose, and oxygen is fed in through the tube at the bottom. The treatment is used for horses after transfer from warm to cold climates or racing in damp evening air.

Micro-miniature camera

At right is a new camera that takes such tiny photographs that it could record the entire Bible on the face of a penny with room to spare. Each page would be reduced to about one millionth of its original size.

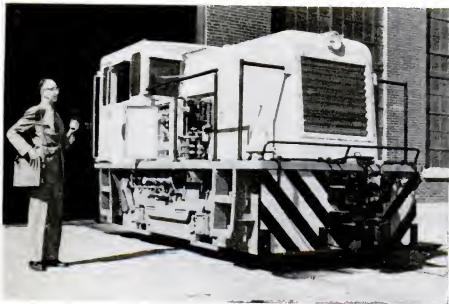
The camera was designed by the National Bureau of Standards for measuring the resolving power of photographic film, plates, and papers.



STEEL HOUSING is moored to building to prevent movement during exposure.



MICROCOPY OF BIBLE PAGE, and a bacteria slide, as seen through same high-powered microscope.



Radio-controlled locomotive

A radio antenna and a couple of black boxes instead of an engineer in the cab drive this diesel-electric switch engine. GE developed the robot for short-line and yard use.

The transmitter that directs the locomotive on its rounds is light enough to be carried over the shoulder of the operator. It works on batteries that are good for eight hours' use before they require recharging.



Lightning strikes radar nose cone

A 1½-million-volt bolt of artificial lightning strikes the Lockheed JetStar radome above without damage. Four strips of foil cemented across the end and grounded to the frame—like a lightning rod—disperse the charge. The nose cone was depressurized for the test to simulate flight at an altitude of eight miles.



Real cool hat

Made of transparent plastic with a sealed-in fluid that retains temperature, this hat is designed to replace the old-fashioned ice bag and hot-water bottle.

Left in the refrigerator the night before, it's just the thing for a morning-after hangover; or heated, it's said to give relief from sinusitis or a winter cold.



Worm's-eye view of a jump

Here's how a paratrooper in action looks from the ground. This unusual photograph was snapped during an assault landing by the 101st Airborne Division during maneuvers at Fort Bragg, N. C. More than 600 tactical aircraft and 50,000 men participated in the jump.



Safe truck transports explosives

To carry explosives in compliance with British safety regulations, this Standard Atlas panel truck was split in two. After a center strip had been cut out and removed from sides and top, double bulkheads were added, completely isolating the dangerous cargo from sparks or fire in the electrical wiring, gas tank, and exhaust outlet. These were all moved to the front.

Amateurs Built These Weird

EVERY year hundreds of people from all over the world get together to show each other their homemade air-planes. Some of the designs are real gone. Some are as sleek as a seal's hide.

A sampling of these backyard-built aircraft is shown on these pages.

The craftsmen who turned them out are members of the Experimental Aircraft Association. This year they held their convention at Rockford, Ill. All pilots, they came from the U. S. mainland, Alaska, Canada, New Zealand, and even India. In all, 83 hand-built planes were on exhibit. Most of them were flown

in. Some were towed behind automobiles.

The planes were, as usual, small. The heftiest horsepower was 160, the least—from a converted Volkswagen engine—36. The fastest plane had a top speed of 200 m.p.h., the slowest 65. None could carry more than four persons; most held only the pilot. They cost as high as \$3,875 (labor not included), as little as \$232, for a machine not yet completed.

The homemade jobs fell into two general categories—those built, or adapted, from designs by professional craftsmen, and those from sketches chalked, in a manner of speaking, on the barn door.



"FLYING FLEA" biplane was built by Frank Easton, Salem, Ohio, at a cost of \$2,000. Easton plans to rig the 16-foot top wing so it can be



swung lengthwise, without removal, for towing the plane on the road. Tips of lower wing already fold to reduce spread to seven feet.



HALF-SCALE JN4 (World War I "Jenny") was built by three Rockford, Ill., men—Lynn Stevenson, Roy Bowers, and Frank Murray. Wheels are from a racing sulky. Engine is a modified Ford Model A. Fuselage is braced with piano wire. Top speed is expected to be 70 m.p.h.—plane hasn't flown yet.



NINE MONTHS AND \$232 were invested by Leon Tefft, Chicago, on his "Molecule." The plane, powered by a Volkswagen engine, has an empty weight of only 300 pounds, a wing span of only 18 feet. The propeller is hand-carved. Cruising speed of the Molecule is 65 m.p.h.

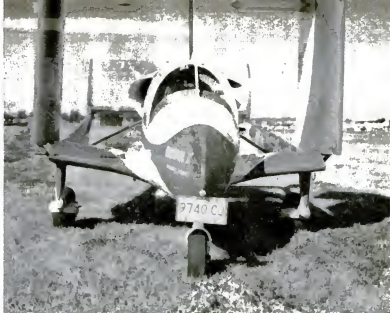


HIGH-WING MONOPLANE with underpinning that looks like a dachshund's was built by a couple of Massachusetts men, Joseph Rogers of Swansea and Charles Grow of Fall River. The "Glad-Juan," as they call their plane, took 18 months of work and \$1,100 in materials.

Airplanes



BRYAN II, as this homemade airplane is called, goes as slowly as 10 m.p.h.—on the road under its own power, that is. Wings fold to enclose prop for safety in traveling on the highway. Plane was built by Leland Bryan who works for General Motors at Milford, Mich. Bryan worked on his flying machine for two years and spent approximately \$1,000 on materials.



CHUPAROSA—Spanish for “hummingbird”—(above) was built in nine years by a Texas furniture-shop owner, Ray Hegy of Marfa. His total money outlay was \$600. The tiny craft's wing span is only 13 feet. Cruising speed is 120 m.p.h., weight 725 pounds.

SINGLE-SEATER DSA (“Darn Small Airplane”) ▶ Miniplane was designed by Frank Smith of Fullerton, Calif., built by Lee Waincott and Howard Terrill. It cost \$1,500, has a cruising speed of 120 m.p.h. Twin above it at right is one of four others built by EAA members.



ANOTHER ROADABLE PLANE was built by Neal Loving, Detroit, in charge of Wayne University's aero lab. Construction took 23 months.

Cost: \$1,800. Carrying two persons, the plane cruises at 100 m.p.h. Wings fold without disconnecting control cables or struts.

Biggest Solar Telescope to Spy Out Sun's Secrets

WHAT causes the violent eruptions of flaming gases on the sun's surface? Why are sunspots often accompanied by magnetic storms on earth? What is the nature of the corona, the strangely luminous outermost layer of the sun's atmosphere?

Soon these and many other questions about the star that keeps our planet alive may be answered by the world's largest solar telescope, now under construction at Kitt Peak National Observatory, near Tucson, Ariz. The giant instrument will provide sun images up to 34 inches in diameter, many times larger than those of any other solar telescope.

It will transmit the images via three front-coated mirrors. The primary mirror, an 80-inch flat heliostat, will be tilted by clockwork to reflect sunlight constantly down a 480-foot optical shaft to a secondary mirror, a 60-inch parabolic unit. From here the image will be reflected back 280 feet and focused on a 48-inch flat mirror, whence it will be directed to an underground observation room. The image can then be photographed or shunted to spectroscopes, devices that divide light into its component parts.

The telescope is expected to be completed in late 1961 or early 1962.

PATH OF SUNLIGHT is shown by arrows. The 300-foot-focal-length telescope will stand atop 6,875-foot Kitt Peak, where the rarefied air permits clearer images. Mirror coating is too fragile to be cleaned, so mirrors will be re-coated periodically in the aluminizing room. Water-cooled windshield cools the air in the optical tunnel to minimize distortion.





SUNLIGHT

80-INCH
HELIOSTAT

WATER-COOLED
WINDSHIELD

HELIOSTAT
SUPPORT TOWER



Self-righting lifeboat

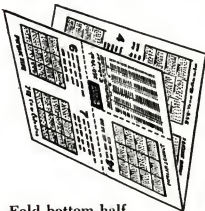
Cables were used to turn this new lifeboat upside down in the water during a demonstration (top) at Amsterdam. Without assistance and with ropes still dangling from a crane above, the steel-hulled boat righted itself in just six seconds. It is being put into service at the station on Terschelling Island off the northern coast of the Netherlands.

250-Year Calendar for Your Wallet

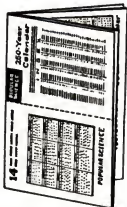
JUST CLIP AND FOLD

WERE you born on a Sunday? Will your silver wedding anniversary fall on a Saturday? Was Lincoln shot on a Friday? Will July 4, 1972, herald a three-day weekend? What about 1999?

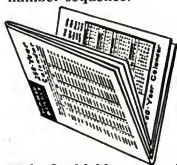
You can check those dates as well as keep track of the current year with the wallet-sized calendar you can make by clipping and folding the facing page.



Fold bottom half under top. Note number sequence.

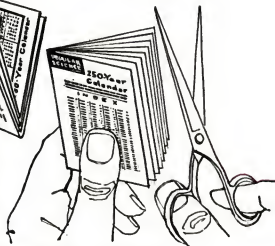


Fold left side under right side along dashed line.



Make final fold to booklet form along dashed line.

Now carefully snip open the folds at tops and sides.



Result: A handy 250-year calendar that you can use to amaze your friends and win bets.

THE NEW YORK PUBLIC LIBRARY

FEBRUARY		JUNE		OCTOBER	
SWIMTWS	SWIMTWS	SWIMTWS	SWIMTWS	SWIMTWS	SWIMTWS
1	1	1	1	1	1
2	2	2	2	2	2
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[illegible]

WONG

250-Year Calendar

Look for the year you want at left. The number opposite tells you which calendar to use.

1778.	91798.	31820.	141842.	71911.
1777.	47599.	31821.	21843.	91111.
1776.	17777.	47598.	31822.	31844.
1775.	17778.	57800.	41823.	18445.
1774.	17779.	61801.	51824.	21846.
1773.	17780.	71802.	61825.	31847.
1772.	17781.	81803.	71826.	41848.
1771.	17782.	91804.	81827.	51849.
1770.	17783.	101805.	91828.	61850.
1769.	17784.	111806.	101829.	71851.
1768.	17785.	121807.	111830.	81852.
1767.	17786.	131808.	121831.	91853.
1766.	17787.	141809.	131832.	101854.
1765.	17788.	151810.	141833.	111855.
1764.	17789.	161811.	151834.	121856.
1763.	17790.	171812.	161835.	131857.
1762.	17791.	181813.	171836.	141858.
1761.	17792.	191814.	181837.	151859.
1760.	17793.	201815.	191838.	161860.
1759.	17794.	211816.	201839.	171861.
1758.	17795.	221817.	211840.	181862.
1757.	17796.	231818.	221841.	191863.
1756.	17797.	241819.	231842.	201864.
1755.	17798.	251820.	241843.	211865.
1754.	17799.	261821.	251844.	221866.
1753.	17800.	271822.	261845.	231867.
1752.	17801.	281823.	271846.	241868.
1751.	17802.	291824.	281847.	251869.
1750.	17803.	301825.	291848.	261870.
1749.	17804.	311826.	301849.	271871.
1748.	17805.	321827.	311850.	281872.
1747.	17806.	331828.	321851.	291873.
1746.	17807.	341829.	331852.	301874.
1745.	17808.	351830.	341853.	311875.
1744.	17809.	361831.	351854.	321876.
1743.	17810.	371832.	361855.	331877.
1742.	17811.	381833.	371856.	341878.
1741.	17812.	391834.	381857.	351879.
1740.	17813.	401835.	391858.	361880.
1739.	17814.	411836.	401859.	371881.
1738.	17815.	421837.	411860.	381882.
1737.	17816.	431838.	421861.	391883.
1736.	17817.	441839.	431862.	401884.
1735.	17818.	451840.	441863.	411885.
1734.	17819.	461841.	451864.	421886.
1733.	17820.	471842.	461865.	431887.
1732.	17821.	481843.	471866.	441888.
1731.	17822.	491844.	481867.	451889.
1730.	17823.	501845.	491868.	461890.
1729.	17824.	511846.	501869.	471891.
1728.	17825.	521847.	511870.	481892.
1727.	17826.	531848.	521871.	491893.
1726.	17827.	541849.	531872.	501894.
1725.	17828.	551850.	541873.	511895.
1724.	17829.	561851.	551874.	521896.
1723.	17830.	571852.	561875.	531897.
1722.	17831.	581853.	571876.	541898.
1721.	17832.	591854.	581877.	551899.
1720.	17833.	601855.	591878.	561900.
1719.	17834.	611856.	601879.	571901.
1718.	17835.	621857.	611880.	581902.

JANUARY		MAY		SEPTEMBER	
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REPORT OF THE

14 1780 1848 1916 1972 2000

[illegible][illegible]

THE UNIVERSITY OF CHICAGO

	1812	1868	1908	1964	2020
11					

[illegible]

	JANUARY	MAY	SEPTEMBER
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1781	1827	1877	1917	1962	2007
1787	1838	1883	1923	1973	2018

[illegible]

SEPTEMBER	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
OCTOBER	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
NOVEMBER	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
DECEMBER	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
JANUARY	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
FEBRUARY	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
MARCH	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
APRIL	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
MAY	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
JUNE	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
JULY	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
AUGUST	S M T W T F S	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

POPULAR SCIENCE

250-Year Calendar

POPULAR SCIENCE

250-Year Calendar

250-Year Calendar

JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER																																							
S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

JANUARY							FEBRUARY							MARCH							APRIL							MAY							JUNE							JULY							AUGUST							SEPTEMBER							OCTOBER							NOVEMBER							DECEMBER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
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JANUARY		MAY		SEPTEMBER	
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JANUARY		MAY		SEPTEMBER	
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250-Year Calendar

JANUARY		MAY		SEPTEMBER	
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JANUARY		MAY		SEPTEMBER	
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31		31		30	

JANUARY							FEBRUARY							MARCH							APRIL							MAY							JUNE							JULY							AUGUST							SEPTEMBER							OCTOBER							NOVEMBER							DECEMBER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T

JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER																																							
S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F	S	M	T	W	T	F														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

	1977	1817	1862	1913	1958	2003
4	1763	1823	1673	1919	1969	2014
	1784	1834	1879	1630	1675	2025
	1800	1845	1890	1641	1686	

1776	1844	1912	1966	2024
1816	1872	1940		

8	1792	1832	1866	1956	1984	2012
	1804	1860	1926			

	1976	1981	1986	1991	1996	2001	2006	2009	2015
5	1776	1618	1683	1914	1959				
	1786	1828	1874	1925	1970	1981			
	1795	1835	1885	1931	1981				
	1801	1846	1891	1942	1987				

1786	1837	1992	1922	1967	2017
1797	1843	1893	1933	1978	2023
1809	1854	1900	1938	1989	

12	1794	1852	1920	1976	2004
	1824	1880	1948		

13	1796	1836	1892	1932	1966
	1809	1864	1904	1990	2016

1886	6	1914	5	1942	5	1970	5	1898	5
1897	7	1915	6	1943	6	1971	6	1899	6
1898	8	1916	14	1944	14	1972	14	2000	14
1899	3	1917	2	1945	2	1973	2	2001	2

1826			1871			1911			1961			2006		
JANUARY			MAY			SEPTEMBER								
S	M	T	S	M	T	S	M	T	S	M	T	S	M	T
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
4	5	6	4	5	6	4	5	6	4	5	6	4	5	6
7	8	9	7	8	9	7	8	9	7	8	9	7	8	9
10	11	12	10	11	12	10	11	12	10	11	12	10	11	12
13	14	15	13	14	15	13	14	15	13	14	15	13	14	15
16	17	18	16	17	18	16	17	18	16	17	18	16	17	18
19	20	21	19	20	21	19	20	21	19	20	21	19	20	21
22	23	24	22	23	24	22	23	24	22	23	24	22	23	24
25	26	27	25	26	27	25	26	27	25	26	27	25	26	27
28	29	30	28	29	30	28	29	30	28	29	30	28	29	30
31			31			31			31			31		

JANUARY		MAY		SEPTEMBER	
S	M	T	W	T	F
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31					

JANUARY		MAY		SEPTEMBER	
S	M	T	W	T	F
S	M	T	W	T	F
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31					

1891..5	1819..4	1847..4	1875..4	2003..4
1892..13	1820..12	1848..12	1879..12	2004..12
1893..1	1821..7	1849..7	1877..7	2005..7
1894..2	1922..1	1850..1	1878..1	2008..1
1895..3	1923..2	1951..2	1879..2	2007..2
1896..1	1924..10	1952..10	1879..10	2009..10

FEBRUARY		JUNE		OCTOBER	
S	M	T	W	T	F
1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31					

FEBRUARY			JUNE			OCTOBER		
S	M	T	S	M	T	S	M	T
1	2	3	6	7	8	3	4	5
4	5	6	9	10	11	6	7	8
7	8	9	12	13	14	9	10	11
10	11	12	15	16	17	12	13	14
13	14	15	18	19	20	15	16	17
16	17	18	21	22	23	18	19	20
19	20	21	24	25	26	21	22	23
22	23	24	27	28	29	24	25	26
25	26	27				27	28	29
28	29	30				30	31	

31	FEBRUARY							JUNE							OCTOBER						
	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5
6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
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5	6	7	8	9	10	11	12	13	14	15	16	17	18	1							

1998..	7	1928..	8	1954..	9	1882..	6	2010..	6
1899..	1	1927..	7	1955..	7	1943..	7	2011..	7
1900..	2	1928..	8	1956..	8	1944..	8	2012..	8
1901..	3	1829..	3	1957..	3	1945..	3	2013..	3
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[illegible]

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31						31						31					
MARCH						JULY						NOVEMBER					

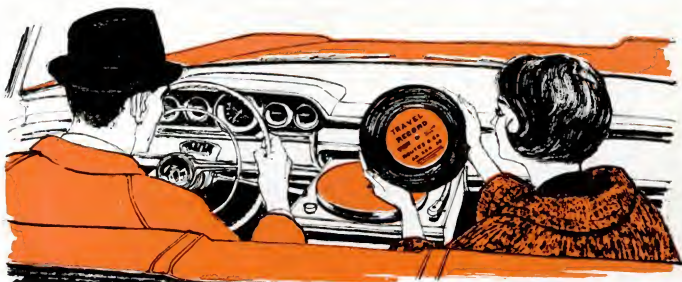
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1908	1	1936	1	1864	1	1992	1	2020	1
1909	1	1837	1	1865	1	1993	1	2021	1

[illegible][illegible]

☐ All day ☐ 1/2 day ☐ 1/4 day ☐ 1/8 day ☐ 1/16 day ☐ 1/32 day ☐ 1/64 day ☐ 1/128 day ☐ 1/256 day ☐ 1/512 day ☐ 1/1024 day ☐ 1/2048 day ☐ 1/4096 day ☐ 1/8192 day ☐ 1/16384 day ☐ 1/32768 day ☐ 1/65536 day ☐ 1/131072 day ☐ 1/262144 day ☐ 1/524288 day ☐ 1/1048576 day ☐ 1/2097152 day ☐ 1/4194304 day ☐ 1/8388608 day ☐ 1/16777216 day ☐ 1/33554432 day ☐ 1/67108864 day ☐ 1/134217728 day ☐ 1/268435456 day ☐ 1/536870912 day ☐ 1/1073741824 day ☐ 1/2147483648 day ☐ 1/4294967296 day ☐ 1/8589934592 day ☐ 1/17179869184 day ☐ 1/34359738368 day ☐ 1/68719476736 day ☐ 1/137438953472 day ☐ 1/274877906944 day ☐ 1/549755813888 day ☐ 1/1099511627776 day ☐ 1/2199023255552 day ☐ 1/4398046511104 day ☐ 1/8796093022208 day ☐ 1/17592186044416 day ☐ 1/35184372088832 day ☐ 1/70368744177664 day ☐ 1/140737488355328 day ☐ 1/281474976710656 day ☐ 1/562949953421312 day ☐ 1/1125899906842624 day ☐ 1/2251799813685248 day ☐ 1/4503599627370496 day ☐ 1/9007199254740992 day ☐ 1/18014398509481984 day ☐ 1/36028797018963968 day ☐ 1/72057594037927936 day ☐ 1/144115188075855872 day ☐ 1/288230376151711744 day ☐ 1/576460752303423488 day ☐ 1/1152921504606846976 day ☐ 1/2305843009213693952 day ☐ 1/4611686018427387904 day ☐ 1/9223372036854775808 day ☐ 1/18446744073709551616 day ☐ 1/36893488147419103232 day ☐ 1/73786976294838206464 day ☐ 1/147573952589676412928 day ☐ 1/295147905179352825856 day ☐ 1/590295810358705651712 day ☐ 1/1180591620717411303424 day ☐ 1/2361183241434822606848 day ☐ 1/4722366482869645213696 day ☐ 1/9444732965739290427392 day ☐ 1/18889465931478580854784 day ☐ 1/37778931862957161709568 day ☐ 1/75557863725914323419136 day ☐ 1/151115727451828646838272 day ☐ 1/302231454903657293676544 day ☐ 1/604462909807314587353088 day ☐ 1/1208925819614629174706176 day ☐ 1/2417851639229258349412352 day ☐ 1/4835703278458516698824704 day ☐ 1/9671406556917033397649408 day ☐ 1/19342813113834066795298816 day ☐ 1/38685626227668133590597632 day ☐ 1/77371252455336267181195264 day ☐ 1/154742504910672534362390528 day ☐ 1/309485009821345068724781056 day ☐ 1/618970019642690137449562112 day ☐ 1/1237940039285380274899124224 day ☐ 1/2475880078570760549798248448 day ☐ 1/4951760157141521099596496896 day ☐ 1/9903520314283042199192993792 day ☐ 1/19807040628566084398385987584 day ☐ 1/39614081257132168796771975168 day ☐ 1/79228162514264337593543950336 day ☐ 1/158456325028528675187087900672 day ☐ 1/316912650057057350374175801344 day ☐ 1/633825300114114700748351602688 day ☐ 1/1267650600228229401496703205376 day ☐ 1/2535301200456458802993406410752 day ☐ 1/5070602400912917605986812821504 day ☐ 1/10141204801825835211973625643008 day ☐ 1/20282409603651670423947251286016 day ☐ 1/40564819207303340847894502572032 day ☐ 1/81129638414606681695789005144064 day ☐ 1/162259276829213363391578010288128 day ☐ 1/324518553658426726783156020576256 day ☐ 1/649037107316853453566312041152512 day ☐ 1/1298074214633706907132624082305024 day ☐ 1/2596148429267413814265248164610048 day ☐ 1/5192296858534827628530496329220096 day ☐ 1/10384593717069655257060992658440192 day ☐ 1/20769187434139310514121985316880384 day ☐ 1/41538374868278621028243970633760768 day ☐ 1/83076749736557242056487941267521536 day ☐ 1/166153499473114484112975882535043072 day ☐ 1/332306998946228968225951765070086144 day ☐ 1/664613997892457936451903530140172288 day ☐ 1/1329227995784915872903807060280344576 day ☐ 1/2658455991569831745807614120560689152 day ☐ 1/5316911983139663491615228241121378304 day ☐ 1/10633823966279326983230456482242756608 day ☐ 1/21267647932558653966460912964485513216 day ☐ 1/42535295865117307932921825928971026432 day ☐ 1/85070591730234615865843651857942052864 day ☐ 1/170141183460469231731687303715884105728 day ☐ 1/3402823669209384634633746074

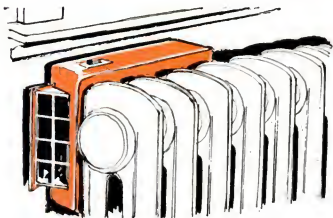
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"I'd like to see them make..."



TRAVEL RECORDS with music between route directions for use in phonograph-equipped cars.

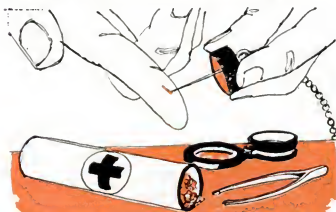
They'd be cheap paper disks to replace unwieldy road maps.—*T. N. Rizzo, Brooklyn, N.Y.*



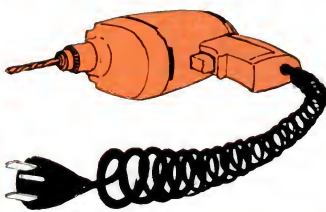
A HEAT-DISPERSING FAN flat enough to hang between the wall and radiator where heat gets pocketed. It would operate much as a car heater does.—*A. K. Baldenweck, Kirkwood, Mo.*



A TRIPOD FLASHLIGHT STAND, adjustable for height, that would swivel at various angles and lock. This would leave both hands free for the workman.—*H. G. Frank, Teaneck, N.J.*



A SPLINTER-REMOVING KIT for home workshoppers. It would contain all the tools needed for first aid: magnifying glass, tweezers, needle, antiseptic.—*Robert Falk, Chicago.*



NONTANGLING CORDS on electric drills and similar shop equipment. Why can't they be sold with the self-coiling wire now commonly used on telephones?—*W. C. Fox, Nampa, Idaho.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by **POPULAR SCIENCE** readers. What's

yours? We will pay \$5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

Army's New 'Shotgun' Launches Grenades



Smoke round penetrates



FIRING DOWNWARD, impossible with muzzle-loaded weapons such as mortars, is an important advantage of the breech-loaded XM79. It allows ambush from a mountainside or building.



target at 50 yards. For maximum range of over 435 yards, barrel is raised to 30-degree angle.

A RAW early-morning wind swept the flatlands of the Army Proving Ground at Aberdeen, Md., as the squat, brawny sergeant sauntered up with a cardboard box. Inside was the Army's new XM79 grenade launcher, a small, lightweight weapon that looks like a large-bore sawed-off shotgun and works on the same principle.

The sergeant lifted the launcher lightly, broke it as one would a shotgun, and pulled a practice smoke round out of his cartridge belt. The cartridge looked like a bullet with glandular trouble. He loaded the gun, snapped it shut, knelt, and aimed. With a muffled, hollow *thwack*, the grenade hurtled visibly in a shallow arc and tore dead-center through the window target 50 yards away. Successive shots hit within inches of the first.

He reloaded the launcher and handed it to me. It was unexpectedly light even for its small size. With a feeling inside me as if my stomach were playing tag with my liver, I drew the gun to my shoulder. I knew that the firer was protected by a delay-arming fuse; the grenade explodes on impact only after it has been fired. Nevertheless, disturbing thoughts of going up in a puff of billowy smoke danced through my mind.

I tensed myself for a stiff jolt and squeezed the trigger. The recoil was mild.

I watched the grenade sail gracefully, though considerably off-center, through the target.

I shakily handed the gun back to the sergeant and replaced my reporter's pencil under my trigger finger.

Grenade launchers date from Civil War days. By World War I, a number of launchers—using large springs, pneumatic



ALUMINUM BARREL—and chamber—is first ever used on an Army weapon. Result: The 28.6-inch-long launcher weighs only six pounds. Use of the light metal is made possible by low chamber pressure and comparatively slow muzzle velocity of its projectile: 250 feet per second.



A FLICK OF THE LEVER and the launcher breaks for loading. Another lever, just behind the first one, is pushed forward lightly by the thumb to release the conventional safety device.



THREE CARTRIDGE TYPES—inert and smoke (both for practice), and high explosive—are being made for the new launcher. They're ballistically matched. Each cartridge weighs nine ounces.



DEEP RIFLING, covering 48 inches in one turn, stabilizes the projectile. A new, adjustable gun sight is replacing the earlier one shown here.



ARCTIC TRIGGER, designed for cold-climate use, allows firing with heavy mittens. A trigger guard swings aside with push of a button.

pressure, or chemical propellants—were in use. These early models invariably were heavy and bulky, and their range and accuracy were poor. The World War II launcher, which was attached to the Garand rifle, was considerably more accurate. But it was an awkward contraption, and high chamber pressure quickly damaged the rifle barrel.

The 40-mm. XM79 is completely dif-

ferent from its predecessors. It is compact and accurate—ideal for house-to-house fighting and for zeroing in on machine-gun emplacements, small troop concentrations, and bunkers. It was developed jointly by the Springfield (Mass.) Armory and the Picatinny Arsenal in Dover, N. J., to fill the gap in range between the hand grenade and the mortar.

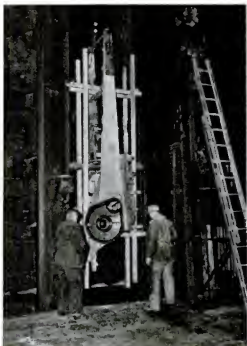
—Alex Markovich.



What is this?

Can you identify the object pictured at left? Check your answer below.

ANSWER: No, they're not buttons or mushrooms, but the suction cups on the tentacles of an octopus. Not imagined or portrayed in fiction, they are used to clamp tightly onto small sea creatures such as shrimp, lobsters, and crabs, which make up the main diet of the octopus.



Lowered down mine shaft . . .



. . . bulldozer is reassembled to push salt around.

Bulldozer goes to work underground

How would you deliver a huge D8 tractor to a salt mine, 1/5 mile down, through a 58-by-60-inch shaft? Here's how a Detroit Caterpillar dealer did it:

He dismantled the crawler and attachments and lowered them, part by part,

down the mine's shaft. At mining level, they were reassembled, equipped with an exhaust scrubber to remove carbon monoxide and conserve air, and put to work pushing International Salt's salt—up to 10 tons at a pass—onto conveyor belts.



Bath is drawn from a water tank in the recess.



Bath finished, tub folds back into the wall.

Disappearing bathtub

A bathtub that folds into the wall when not in use was shown at a recent industrial exhibit in Rome. It is expected to be a welcome space-saver to housewives in small, cramped apartments.

A YEAR ago Popular Science began reporting on the road performance and fuel consumption of the first compact cars—the Corvair, Falcon, and Valiant. We drove each of them 10,000 miles in a month, a test never undertaken before—or since—by any other big-circulation magazine.

Now we've done it again. Here is the first report on one of Detroit's spanking-new 1961 smaller cars, the Oldsmobile F-85. We piled on more than 10,000 miles—again, in one month—over the routes shown on the map here.

The F-85 was purchased at its full retail price (\$2,803 before state taxes) from a regular dealer. It was a manual-shift, four-door station wagon, with only a heater, radio, outside mirror, and windshield washers as accessories. Its engine was Olds' new aluminum V-8.

Next month: 10,000 miles in a Pontiac Tempest.

Testing the New Little Oldsmobile:

10,000 Miles in an



HOW THE F-85 DID

Top speed 100-plus m.p.h.
Speedometer error

Indicated Speed	Actual Speed
40 m.p.h.	39 m.p.h.
50 m.p.h.	48 m.p.h.
60 m.p.h.	58 m.p.h.
70 m.p.h.	66.5 m.p.h.

THE COSTS

Gasoline	\$165.43
Oil burned	2.38
Gas-oil cost per mile	.0162
Repair and maintenance, including adjustments at 500, 1,000, and 5,000 miles	
Oil changes	\$4.40
Lubrication	5.25
Transmission lubricant.	1.30
Labor charges	None
Total	10.95
Overall direct operating cost per mile	.0172

THE PERFORMANCE

Total distance covered	10,355.9 miles
Gasoline used (non-premium)	512.3 gal.
Average miles per gallon	20.21
Oil burned	4 qt.
Gas mileage at constant speeds	
30 m.p.h.	27.9
40 m.p.h.	26.8
50 m.p.h.	24.9
60 m.p.h.	21.6
Gas mileage in stop-and-go driving	15.03
Acceleration	
0-60 m.p.h.	13.8 seconds
40-60 m.p.h.	9 seconds
50-70 m.p.h.	7.5 seconds

None of the Popular Science compact cars—this year or last—was driven harder, at higher speeds, for the 10,000-mile test than the Olds F-85 station wagon



Deer jumps out of underbrush. Fermoye hits brakes hard at 65 m.p.h. Bad for Fermoye's blood pressure; very good for deer.

Lots of road-building activity—but oh those detours!

Car checked over at 1,350 miles. Timing reset, brakes adjusted, and so forth.

Capsule report from Rowsome: "It's a vanilla-flavored automobile—short on personality. Brakes and steering are dandy. That V-8 idles with delicious smoothness. And it sure is sassy in second."

Fermoye takes a long lunch hour to watch last five innings of seventh World Series game.

Markovich drives into Olds agency. Mechanic tries to shoo him away—"This isn't the Ford place."

"I'll be darned," said the gas-pump jockey. "They've finally built an aluminum engine."

Lucky picks up speeding ticket—66 m.p.h. in a 55-mile zone (\$17.75).

Agent for competitive car (R-----r) inspects F-85 critically, declares, "It'll never sell."

Little brown dog pops out into road. Sudden stop collapses rear seat and tumbles Ortner luggage forward.

Ortner is tickled pink when distinguished-looking gent dashes over, introduces himself as a great fan of magazine that pays his (Ortner's) grocery bills.

Layout under the hood is a mechanic's dream—you can even get at the plugs!

Lucky decides that the F-85 quashes once and for all that old bunk about "you gotta have a heavy car to get stability."

General agreement—no like one-piece tailgate.

F-85

Turn the page for the F-85 report





Lightweight engine made steering easy. Here Evelyn Ortner maneuvers the F-85 out of a cramped Atlanta garage. She loved driving the little Olds—especially at speeds that left her husband ashen.

IN Baltimore, Md., one night last October, a gas-pump jockey filled the tank of the POPULAR SCIENCE F-85 station wagon and then raised the hood. He stared at the engine.

The PS reporter who was driving the car proffered money for the fuel. The filling-station man ignored him as if, at a time like this, money were unimportant. "I'll be darned," he said. "They've finally built an aluminum engine."

The F-85's lightweight aluminum V-8 engine follows by a year Chevrolet's revolutionary pancake six in the Corvair. Produced by Buick as well as Olds, the aluminum V-8 powers, with modifications, not only the F-85 and Buick Special, but also—as an option—the Pontiac Tempest.

It's sassy. It's happiest at high r.p.m. By plucking hundreds of pounds off the front wheels, it returns the steering effort, without power assist, to the ease of 30 years ago.

A half-dozen POPULAR SCIENCE staff members drove the car an average of almost 400 miles a day for four weeks. Their reactions to the F-85 on performance and quality varied widely. This much they agreed on: The car rides beautifully. It handles well. Its engine is, for a V-8, impressively economical. In 10,000-plus miles of hard driving, not one mechanical repair had to be made. They agreed, too, that the F-85 has its debits.

Beyond these general verdicts, some disagreements cropped up, as reflected in the following round-table discussion by this magazine's staff members.

Only hours old, the PS F-85 began rolling up mileage. It had to average almost 400 miles a day for a month.

Fuel Consumption

Kenneth Fermoye: I got exactly 19 miles to the gallon in 2,667 miles of driving. That included a lot of miles at 65 an hour. I got 22.8 to the gallon at lower speeds.

Frank Rowsome: That's pretty good. This is a relatively heavy wagon.

Everett Ortner: I averaged 18.9 miles to the gallon for a little less than 2,500 miles.

Alex Markovich: We're all roughly in the same range for highway driving—in 500 miles I averaged 19.

Hubert Luckett: Except me. You fellows must have heavy feet. A friend and I covered more than 3,000 miles in four days, and got 21 miles to the gallon.

Rowsome: The fact that the car was just getting nicely broken-in surely had something to do with that.

Devon Francis: Let's note the figure on stop-and-go, because that's where 95 percent of everybody's normal driving is done. I got 15.03 miles to the gallon on several hundred miles of heavy traffic.



How the F-85's Tires Stood Up

Tread depth of the 6.50x13 Royal tires was measured at 10,000 miles. The left-front had lost 30 percent; the other three (four shared all the wear), 40 percent. Excessive center wear, said the tire expert, reflected extra pressures of high-speed driving. His estimate of tire life: 25,000 miles on four tires, 31,000 on five tires switched each 5,000 miles.

Handling

Fermoye: The gearshift was a bit stiff.

Markovich: I didn't like that, either. The shift throws are too long. The dog-leg between first and second is exaggerated, preventing fast shifts.

Rowsome: Only a hot-rodder like you would complain about that.

Ortner: I found it hard to make a completely smooth shift.

Luckett: I agree with Alex. The gear-shifting was rough and slow. The throws were too long. I've got other beefs. The clutch pedal was stiff, and the travel too long. The brakes tended to be slightly grabby in traffic.

Francis: That's not the way you talked when you returned from your trip.

Luckett: I'm just giving you Act One, Scene One. Wait a minute.

Markovich: The steering takes five and a half turns lock to lock.

Rowsome: It's not quick enough, but it's precise.

Fermoye: The car tracks beautifully,



The Ortner's discovered a use for that extra space in the under-floor spare-tire well: It was handy for soiled laundry.



Rear-seat locks didn't hold securely. In emergency stop, luggage came hurtling forward, collapsing the rear seat.

How the F-85 compared with Popular Science's 1960 Corvair, Falcon, and Valiant

	F-85	Corvair	Falcon	Valiant
Overall average miles per gallon	20.21 m.p.g.	23.43 m.p.g.	26.56 m.p.g.	20.31 m.p.g.
Gas mileage at constant speeds				
30 m.p.h.	27.9 m.p.g.	26.6 m.p.g.	30.2 m.p.g.	25.8 m.p.g.
40 m.p.h.	26.8 m.p.g.	24.2 m.p.g.	29 m.p.g.	24.2 m.p.g.
50 m.p.h.	24.9 m.p.g.	23.6 m.p.g.	28.1 m.p.g.	23.9 m.p.g.
60 m.p.h.	21.6 m.p.g.	22.8 m.p.g.	27.1 m.p.g.	22 m.p.g.
Miles per gallon in stop-and-go driving	15.03 m.p.g.	21 m.p.g.	22.4 m.p.g.	19.6 m.p.g.
0-60 acceleration	13.8 sec.	17 sec.	22.9 sec.	17 sec.
Top speed	100-plus	88 m.p.h.	78 m.p.h.	96 m.p.h.
Total oil consumption	4 qt.	4 qt.	1 qt.	3 qt.
Gas-oil cost per mile	\$.0162	\$.0145	\$.0122	\$.0163
Overall direct operating cost per mile	\$.0172	\$.0184	\$.0147	\$.0206



Hanging from radio knobs is the logbook. Recorded in it was every drop of gas pumped in the tank, every quart of oil, every bit of servicing.

Four-by-eight panel of plywood can be carried, though it has to ride on the wheel housings. And the big tailgate won't fully close.



without constant steering corrections.

Markovich: There's a neutral-to-mild understeer through tight corners.

Fermoye: Up in northern Michigan, a deer jumped into the road ahead of me. I had to slam on the brakes and slide all four wheels. The brakes are really good.

Ortner: The car handled nicely at high speeds and on mountain curves. It wanted to follow the road. My wife was surprised at how easily it steered without a power assist.

Luckett: The F-85 is one of the least wind-sensitive wagons I've ever driven.

Fermoye: On handling, the car is a good cut above average. I never had the feeling that it was going to swap ends on me.

The Ride

Rowsome: On a rough road at 55-60, the ride is good.

Luckett: It's better than good. This car has an almost uncanny ability to keep its feet on the ground over rough roads.

Fermoye: The ride was so smooth that I couldn't even feel the tar separation strips on a concrete expressway.

Ortner: I want to emphasize that. The ride was one of the numerous good things about the F-85. The suspension damped out major road shocks, but still transmitted enough information to give the driver a sense of participation in rolling along.

Luckett: We found the car's stability at speed was improved a lot by boosting tire pressure from the 22 pounds they recommend to 25. There was little penalty in harshness. Let me make one more point about the ride. When you first get into the car, you think the suspension is too soft. It isn't. The car doesn't wallow or heel on hard turns.

Performance

Markovich: Its acceleration is deceptive because it runs so quietly and revs up so fast.

Ortner: When my wife drove, the needle kept creeping up to 85 m.p.h.

Markovich: But in the lower ranges, you get performance only if you wring out first and second gears.

Francis: I kept killing the engine, at first, in low gear.

How Well Was It Designed and Built?

The Olds F-85 is a well-mannered car that reflects the manufacturer's concern with quality control.

All automobiles have their shortcomings. PS drivers reported these:

- Both the clutch-pedal travel and the manual-transmission throws are too long.
- The axle ratio produces a surly behavior for those who dislike shifting in traffic.
- Seat backs could be higher and their contour improved.

- The wind noise is high with the windows or vents open.
- Tall drivers will find the top of the windshield frame too close to their heads.
- Those who like ammeter, oil-pressure, and temperature gauges will be annoyed by the substitute "idiot lights."
- The rear fold-down seat fastens insecurely.
- Some drivers won't like the one-piece tailgate.
- Some won't like one-speed wipers.

With power to keep up with—or ahead of—traffic on hilly roads, the F-85 need get in nobody's way. Here it was coming east on the Pennsy Turnpike, nearing an old railroad tunnel. Most of its drivers rated it as a fine over-the-road car with light-to-medium loads.



Rowsome: I don't see why. It's smooth, it doesn't fidget, it revs willingly, and has plenty of sass in second at 55.

Francis: It was draggy at low speeds.

Rowsome: Automatic-transmission dummoes will probably shift it too low, and then bellyache over poor torque.

Fermoyle: The engine lugged in high gear under 20 m.p.h.

Francis: That's right, it spooks under 20.

Fermoyle: But there's oomph for passing in the 50-70 range. You don't feel deprived, the way you do in some compacts and imports.

Rowsome: A simple change in axle ratio, or an automatic box, would take care of your carps on low-speed performance.

Luckett: Yes, at a cost in gas economy. This engine sparkles in the higher ranges. I was still accelerating when the speedometer needle ran past the 100-m. p. h. mark. I don't know what the speedometer error was at that point, but at 60 it was only a little over three percent.

Ortner: You go ahead and be forgiving if you want. I was perfectly happy with

the car above 50. But in city driving, you find yourself shifting into second every time you want to pass.

Francis: Well, what's wrong with using second gear as a traffic gear?

Design and Construction

Rowsome: The clips at the back of the top of the rear seat chirrup—like all wagons with folding second seats.

Ortner: Worse than that, they let go. Once all our luggage slid almost onto our backs in a hard stop.

Fermoyle: A squeak developed under the dash at 100 miles. And the tailgate began rattling.

Francis: I heard that, too. It wasn't the tailgate, it was the rear seat.

Markovich: The front of the hood kept

[Continued on page 230]

A Reader by Radar

The arresting officer was dawdling outside as we came out of the roadside farmhouse. We had just finished transacting our business with the State of Virginia (66 m.p.h. in a 55-m.p.h. zone: \$17.75). A charming lady justice of the peace had thanked us as she made change. "Those Oldsmobiles must be wonderful cars," she chatted. "Seems like we get more Olds customers than any others."

Falling into step beside us as we walked back to the car, the trooper dropped his official manner. "What kind of mileage you getting?" he asked. "How's she handle?" We told him.

"Mind if I look at the engine?" We raised the hood. "What issue will the article be in?" he asked.

We had picked up another reader—the hard way.—Hubert Luckett.



Study in contrast: F-85 with '32 Olds. Owner: Mickey Camp, East Ridge, Tenn.



Imports have economy run, too

This four-passenger Morris Mini-Minor did 55.44 miles per gallon to place first in gas economy both in its class (750 to 1,099 cc.) and among all sedans that competed in the third annual Mobil mileage rally for foreign cars.

The 34 entries averaged 40.23 miles per gallon in a 200-mile run through three

states and 46 cities and towns. Other winners: Renault, under 750 cc., 49.18 m.p.g.; Fiat, 1,100 to 1,599 cc., 40.55; Citroen, over 1,600 cc., 35.98. In two sports-car classes, an NSU Sport Prinz (under-1,600-cc. class) got 62.29 m.p.g., and a Triumph TR-3 (over-1,600-cc.) averaged 32.23 m.p.g.



Upper and lower shells are water-sealed by gasket.



Outboard prop sticks through pod.

Water skiing without a tow

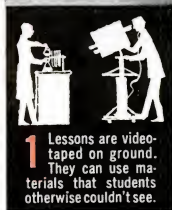
This water-riding Ski-Horse is propelled by an outboard motor encased in the pod formed by upper and lower aluminum shells. A rider stands on the

projecting skis and steers by leaning to right or left on the handle. A dead-man switch for safety in spills is included in the controls. S. Jack Magri of Stamford, Conn., designed the Ski-Horse as a class project while at Syracuse University.

Using a converted DC-6 as a flying TV station, 'Stratovision' will teach students their lessons in six states at once

Schoolroom in the Sky

2 Taped programs are broadcast as far as 200 miles from "classroom" in plane 23,000 feet up.



1 Lessons are videotaped on ground. They can use materials that students otherwise couldn't see.

By Alfred W. Balk

FROM more than four miles above the earth, a plane will begin broadcasting lessons by TV to pupils in six Midwestern states late this month.

The experiment will inaugurate Stratovision, a radical new system of long-range telecasting. In school and college classrooms equipped to receive the programs, it will bring instruction by talented teachers to learners of all ages. Its 200-mile range could reach more than 5,000,000 students at once in this Midwest area's 13,000 schools and colleges.

The flying classroom, a DC-6 airliner converted into a TV station, enormously increases the distance that television can be transmitted. Because TV signals travel mainly in a straight line, the curvature of the earth dims reception from a ground station beyond about 50 miles. The aerial telecasts, pre-recorded on videotape, range four times as far.

Cruising at about 250 m.p.h., the Stratovision plane will stay centered over its 400-mile-diameter zone of reception by circling within a 10-mile radius of Montpelier, Ind. Even in high winds it's expected to be able to remain on station

3 TV sets adapted for UHF reception serve up programs to six states' schools and colleges.



CONTINUED

For the first time, small schools can offer advanced math,

by tacking back and forth. For a six-hour telecast, its "flight to nowhere" will take it nearly 2,000 miles, including the 150-mile distance to and from its base at Purdue University airport.

It will fly 23,000 feet up—a height ample to give the wanted TV range, and one approaching the altitude at which the modified DC-6 will operate most efficiently, without trespassing into higher levels reserved for jets.

Beaming the lesson. A wagging 24-foot-long antenna mast on the underside of the fuselage will be the most conspicuous outward feature of the four-engine plane's special equipment. Since the antenna focuses signals directionally in a downward cone, it must be mounted in gimbals and kept pointed vertically at the earth, when the plane banks, by a gyro control. A hydraulic system retracts it flush with the plane's belly for landings and takeoffs.

Twin planes with duplicate equipment give Stratovision a standby. If mechanical trouble forces one plane to break off a telecast, the other will roar aloft and continue the program. And bad weather will rarely let out "TV school." Going

by past weather records, a Stratovision plane should be able to fly on all but four or five days of the school year.

The plane will televise two programs at once, on separate UHF channels, four days a week. Its daily four-hour telecasting schedule, during an initial demonstration period of several months, will be increased to six hours with the start of Stratovision's first full academic year next September. By then, current experiments may have multiplied the number of programs that can be transmitted simultaneously.

Typical Stratovision lessons for elementary-school and high-school pupils will run 15 to 20 minutes apiece; for college students, half an hour.

At the receiving end. Schools will provide the needed equipment to pick up the programs. This may consist of a UHF/VHF television receiver for each classroom, with its individual outdoor antenna—the least expensive plan for, say, two rooms. Another plan, more economical for a large installation, uses a single master antenna outdoors and a central UHF-to-VHF converter, linked to VHF receivers in the rooms.



POWER-SUPPLY CABINET, being wired above, feeds two transmitters that simultaneously broadcast different programs from TV plane.

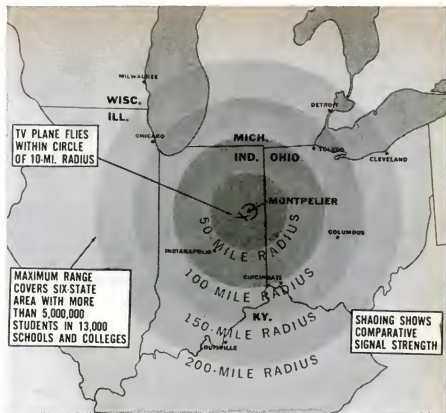


RACKS for five tons of electronic gear are installed in a converted DC-6, one of two which will be used in Stratovision flights.



FOUR-ENGINE PLANE to be used in Midwest program will employ 24-foot-long antenna, which retracts for takeoffs and landings.

SCHOOLS within a circle 400 miles wide (right) will receive the telecasts from plane flying over Montpelier, Ind.



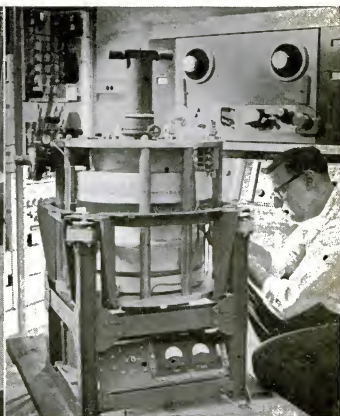
Through Stratovision, small schools—and one-fourth of the U.S. total are one-teacher schools—will be able for the first time to offer courses in languages, advanced mathematics, science, art. Every student, rural or urban, can have superior teachers. Gifted children, no matter

how overworked their teachers, can take advanced courses by Stratovision.

Doing the same thing with films and projectors would cost three times as much as TV, it's estimated. A closed-circuit television system, with land lines to schools so widely scattered, would be



BIG SCOOP supplies air for combustion to 85-kw. gas-turbine generator, installed in tail of plane to power the aerial telecasting station.



PLANE'S EQUIPMENT includes this big klystron tube. It will amplify sound and picture signals 10,000 times for the broadcasting transmitter.



VIDEOTAPING AN ART LESSON: Kids won't have to crane over other heads to see this fingerpainting being made.

CLOSE-UPS OF PLANT LIFE are taped. Other scenes show snakes ejecting venom—impossible to stage in a class.

prohibitively costly; and it would take at least 14 TV ground stations to reach Stratovision's area by way of the ether. That's the why of TV from the sky.

Dream to reality. Stratovision was devised by Charles E. Nobles, a Westinghouse engineer—who proved it would

work, 15 years ago, with a surplus B-29 bomber over the Pittsburgh area. He dreamed of bringing TV to the whole nation at once, with 20 planes. Licensing problems pigeonholed the idea until two years ago. Then a fellow engineer, Reuben Lee, suggested that Stratovision be adapted to educational TV. With front-office encouragement, it was.

Initial result is the Midwest's flying schoolroom. To meet the \$7,000,000 cost of launching the project, the Ford Foundation has put up \$4,500,000 and private industry has contributed the rest. Present sponsors expect to be succeeded by a self-financing interstate association that will continue Stratovision permanently.

If the airborne experiment proves successful, its backers point out, it may open the way for similar projects in other U.S. regions. "Eventually," they say, "a relatively small number of aircraft could provide coast-to-coast educational television."

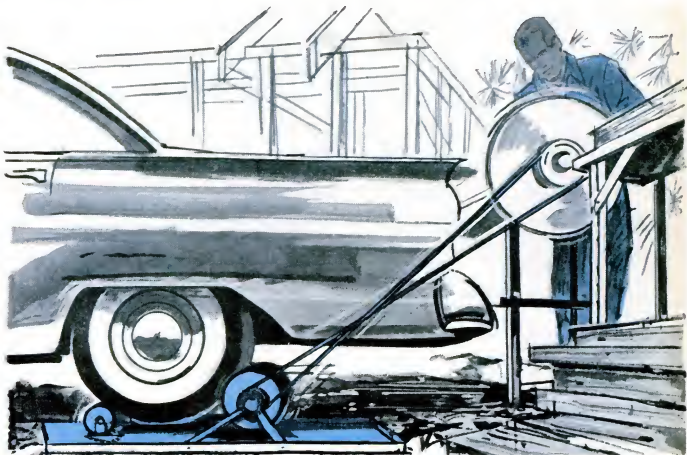
And they have a still bigger dream. In underdeveloped countries, Stratovision's impact would be even more dramatic, for illiteracy would be no barrier. Picture and voice could teach hygiene, language, geography, history, government. A portable generator and TV receivers in each village, plus a handful of airborne TV stations, could make over the most backward regions. It could change the course, some think, of the whole Cold War.



MINIATURE PLANE MOCK-UP helps determine how far transmitting antenna must project down from fuselage, so that the plane's underbody won't reflect and garble signals during turns.

New Ideas from the Inventors

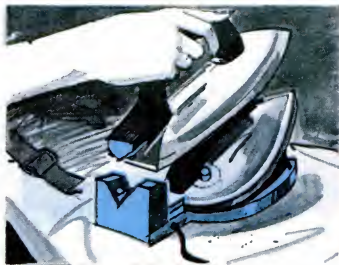
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Car Generates Portable Power. You could carry power—and power tools—to any job with this recently patented take-off. A car wheel, running between two

rollers, would drive a tool, pump, or emergency generator through a pulley or sprocket. A pin would lock the forward roller to let a wheel ride on or off.

Base Heats Cordless Iron. Attached to the stand, rather than to the iron, this electric cord couldn't kink, dangle, or obstruct the work. Placing the iron on the sloped base would depress a switch and allow contacting terminals to deliver current to the iron's heating element.



Bank Pays Out by the Clock. Small fry could collect their daily (or weekly) spending money right on schedule, even when you're away from home. You'd feed coins into this toy bank, and an electric clock would open the dispensing slot at the end of any preselected interval.



More Inventors' Ideas



Magnetic Drum Dials Phone. The dialing clicks or call cycles of up to 50 numbers could be recorded on this Bell Labs automatic dialer. After turning a knob to select the number, you'd "dial" it by pressing a playback button. The numbers could be erased and changed at will.



Scraper Cleans Paint Roller. Squeezing and scraping the surface of a paint roller with this tool, says the inventor, does a "quick and efficient" cleaning job. Made of springy metal, the tool would slip around the roller, gripping it tightly as you moved the roller sidewise.

Tail Fin Pockets Spare. You wouldn't have to unload your luggage to change a flat—or wrestle the spare out of the trunk—if you could reach the extra wheel

through this side-opening fender door. Upswept fins on many cars allow room for the wheel-carrying recess; the cover would be styled as part of the trim.





Slide Seat for Cars. This GM-patented seat might let rear-seat passengers enter or leave a two-door car more easily. Outer ends of front seat would rest on floor-tracked slides connected to a lever in the back. Tilting the back would pull the seat forward to add door clearance.

Dual Pickup Imitates Stereo. Back-to-back cartridges in this tone arm might make your old monophonic records sound almost like the new stereos. Two needles would track the same groove with a slight time difference. When played through a two-channel system, says the inventor, this simulates the space difference recorded on separate tracks of stereo disks.



Bail-Out Stick. Newest "parachute" uses oppositely spinning autogyro-like rotors to slow a fall more efficiently than an air-filled sack. A handle tilts the control column to let the jumper aim his descent. The props would fold and the seat-carrying bar telescope for storage.

The following patents have been issued on these inventions: Power take-off—No. 2,819,617 to R. Milks Sr., Charlotte, N. C.; Cordless iron—No. 2,820,877 to D. Oates Jr., Rocky Mount, N. C.; Bank—No. 2,941,336 to J. Doubleday, Ridgefield, Conn.; Dialer—No. 2,911,043 to J. H. Ham Jr. and H. Hershey, Indianapolis; L. Holmann Jr., Chatham, and F. Kinsman, Madison, N. J.; Scraper—No. 2,825,916 to A. Basala Jr., Detroit; Tire carrier—No. 2,823,068 to B. Walker, Piedmont, Calif.; Car seat—No. 2,826,211 to J. Himka, Detroit; Tone arm—No. 2,821,578 to G. Morrell Jr., Conneaut, Ohio; Chute—No. 2,941,763 to D. Oleksij, E. Orange, N. J. Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.



◀ *Paralyzed city: 25.8 inches*

SNOW is not actually white. It just looks white. Since it is frozen water, it is colorless. Light rays are reflected and bent when they strike the surfaces of the myriad snow crystals. The transparent ice of the flake appears white because it has so many of these reflecting surfaces.

In certain remote parts of the earth, you can sometimes see red snow. At the North and South Poles, for instance. High in the Alps, too, climbers are sometimes startled to come upon a dark red landscape. It is caused by microscopic red plants that grow on the surface of the snow. Black snowfalls have been reported in Virginia. They are produced when carbon particles from factory stacks combine with the falling flakes. Chicago had a brown snowfall in 1947, caused by a dust mixture.

When pollen from pine and cypress trees mingles with snow, you see yellow snowfalls. And there have been reports of blue and green ones.

Fresh snow looks delicate and fluffy. Scoop up a handful and it seems like nothing. A cubic foot may weigh only six pounds. A snowdrift can be extremely light—one part ice crystals and 89 parts air. But when snow is compressed—on your roof, or in mountain crevasses—where it has been hardened by wind and rain, it can weigh up to 30 pounds a cubic foot. It can crush buildings and hurtle into mountain valleys in massive, deadly avalanches.

Snow is not so very cold. In fact, it is one of nature's best insulators. You can test this yourself. Hold a thermometer just above the crust of the snow and take a reading. Now, thrust the thermometer down into the drift and see how much warmer it reads. Farmers know that snow is the overcoat for their fields, holding heat in the ground and keeping the seeds from freezing.

Every state—including Hawaii—gets some snow. It has fallen in Idaho every month of the year. The championship for a single day is held by Silver Lake, Colo. There—on April 14-15, 1921—76 inches fell in 24 hours.

In January, 1952, a four-day snowfall covered Tahoe, Calif., with nine feet. A ranger station in Mount Rainier National Park, in Washington, measured a total of 83.4 feet in the winter of 1955-56. In Michigan, snow piled on the city of Houghton for 52 straight days in the winter of 1951-52, stacking up almost 10 feet.

What Do You Know About Snow?

of snow fell on New York, Dec. 26, 1947, bringing traffic to a standstill

But Tamarack, Calif., holds the record for the greatest measured depth of snow on the ground—454 inches, on March 9, 1919.

When snow descends on a big city, there is the devil to pay. New York was covered with only two feet in December, 1947, and it took \$4,500,000 and 30,000 men to clean it up.

But was it a blizzard? Not that storm. A blizzard means low temperatures, high winds, and driving snow. You can have a blizzard without snow falling, when the winds pick up dry, fine snow off the ground and hurl it so fast you can't see the sky.

In Antarctica, where blizzards are common, there is little snowfall. One year, the U.S. weather station there reported only two inches. Meager water vapor in the intensely cold polar air prevents heavy precipitation. So there's truth in the old saying, "It won't snow today; it's too cold." Unlike hail, snow is not frozen rain; it is frozen water vapor. It forms when the molecules of this vapor, instead of moving freely, slow down, clutch each other and freeze—in an instant—into an endless variety of fragile, jewel-like structures.

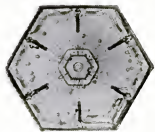
Blame it on the tropics. Curiously, warm tropical air is responsible for much snow. Tropical air contains great amounts of the water vapor needed to make snow. That's why the heaviest snows fall in the mountains of California and the Pacific Northwest. Warm, moisture-filled air from the Pacific cools when it climbs the slopes and condenses.

Here, in the mountains of the West, it is vital to know how much snow actually has fallen during the winter, and what will happen once it begins to melt. To get the answers, Uncle Sam's snow surveyors are at work on their hazardous job from January to May. Pushing along marked trails in the 11 mountain states, they measure the snow, take borings, and weigh the sample cores to determine the water content. Ten inches of snow make just about one inch of water. The surveyors, by calculation and experience, forecast whether streams and reservoirs will be full when the snow melts and whether there will be a drought or flood.

We can thank a New England youth for revealing the marvelous makeup of snowflakes. In 1885, 19-year-old Wilson A. Bentley acquired a microscope and a camera, and used them to enlarge and photograph snow particles in the mountains of Vermont. He devoted his whole life to the study of snow structures and 46 years later he published his discoveries in a classic work, *Snow Crystals*. Bentley became world famous. He took more than 5,000 photomicrographs of snow crystals. Every one was different. Since then, too, no one has ever found two flakes that were exactly alike.

In the snowflake we see the infinitely complex architecture of nature. The form is usually that of a hexagonal star, but each one is a unique masterpiece.—George J. Barmann.

Snowflakes under a microscope

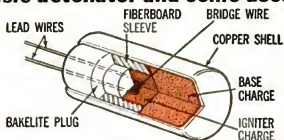


Never two alike, snow crystals share six-pointed shape. These delicate flakes were photographed by Dr. V. J. Schaefer, pioneer in rain-making research.

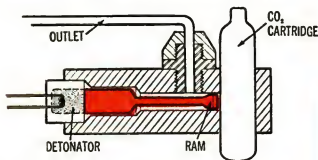


Exploding Hardware Controls Space Rockets

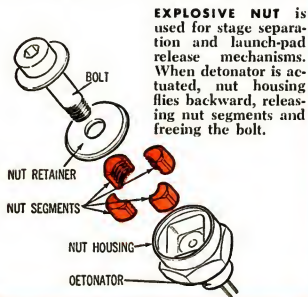
Basic detonator and some uses



THE HEART of most explosive devices made by Conax Corp., Buffalo, N.Y., is this copper-encased detonator. It holds an electrically fired diazodinitrophenol charge.

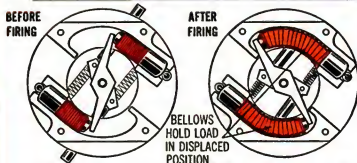
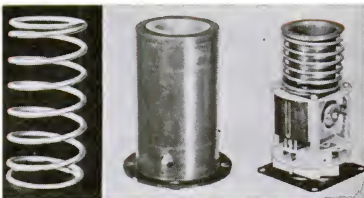


GHOSTLIKE FINGERS separate rocket stages, purge valves, perform many other tasks. Detonator-powered ram pierces CO₂ cartridge, releasing gas under 1,100 p.s.i. pressure.



EXPLOSIVE NUT is used for stage separation and launch-pad release mechanisms. When detonator is actuated, nut housing flies backward, releasing nut segments and freeing the bolt.

Caterpillar motor release



STRONG-ARM TACTICS of this device separated the first two successful Vanguard satellites from their third-stage carriers. Explosives in the two compressed metal bellows detonate on signal, forcing bellows to expand and turn the crank. In Vanguard II (shown at right, minus nose cone, just before firing), 26 seconds after third-stage rocket burned out, the crank released a retaining strap and actuated a four-inch, two-ounce spring that kicked free the satellite. The release mechanism is made by Raymond Engineering Laboratory, Middletown, Conn.

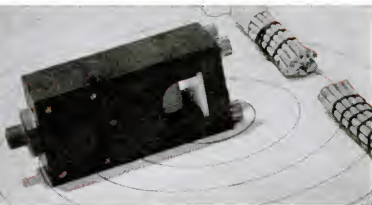


IN THE harshest environment known to man—outer space—tiny explosive mechanisms are operating with near-absolute reliability.

There are many ingenious versions. Basically, all are one-shot “suicide” devices whose explosive charges or squibs are actuated by electrical signals from

the missile's sequence controls. Expanding gases, fluids, or shock waves then are channeled to do useful work. Unaffected by extreme temperatures, vibration, and G forces, the devices throw switches, open valves, separate missile stages, and perform countless other space-probe jobs.—*Richard A. Shaw.*

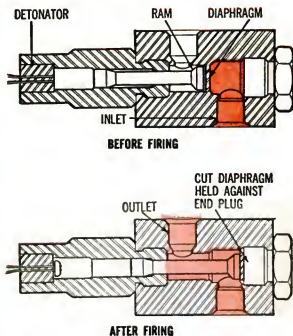
Umbilical guillotine



LIGHTNING-FAST SEVERANCE of the ground-power umbilical cable before blast-off is the function of this cutter made by Beckman & Whitley, Inc., San Carlos, Calif. The unit can cut a 2½-inch steel-jacketed cable in a 12-millisecond stroke. Ceramic blade and anvil eliminate danger of a short circuit between conductors of the cable. Shock wave from explosive charge provides power.



Explosive valve



SOLID DIAPHRAGM in this explosive valve remains leakproof under high pressure. Detonation of the charge forces a sharp ram through the diaphragm and opens the valve. Arrow in photo below points to an explosive valve mounted in the guidance system of a Terrier antiaircraft missile; when the valve is fired, it activates the missile's automatic pilot, which takes over.





FRONT SUSPENSION is transverse leaf (shocks are coming soon); rear end is damped by

rubber pads. The driver's seat has a two-inch clearance. The car cost about \$3,000 to build.

Dragster runs on steam

If you're looking for a car that's powerful, economical, trouble-free, and silent, take a hint from Ford Walters, a Torrance, Calif., mechanic. Walters claims these and many other advantages for steam-powered cars, and he's built a steam dragster to prove it.

The machine, built for quarter-mile

drag-strip competition, has a two-inch chrome-moly tube frame and an aluminum-and-fiber-glass body. A monotube (coil) boiler, mounted far back to increase rear-wheel traction, holds a quart of water. Diesel fuel or stove oil, admitted topside, is ignited by a continuously arcing, battery-operated spark plug.



Portable penthouse

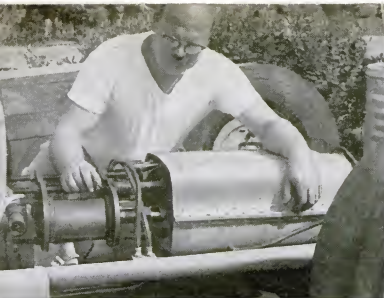
A prefabricated penthouse is hoisted here to the top of the Sylvania Reconnaissance Systems Laboratory at Mountain View, Calif. It was built on the ground and lifted into place. It can be shifted from time to time to other spots on the roof in order to provide interference-free locations for testing military antennas.



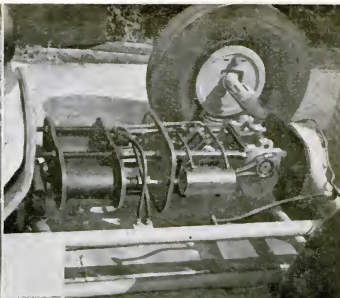
Teeth will bite into snow, mud, or ice

Here's a metal clamp that can be fixed on an automobile tire from one side to provide traction on sand, mud, snow, or ice.

Threads on the center bars pull the teeth up tight when the turn-buckle over the hub is twisted. It's easier than putting on chains and serves the same purpose. The clamp is on display in the Inventors' Pavilion at Rome's permanent industrial exhibit.



ALUMINUM CASING seals everything but the steam cylinders in an oil bath. On passenger cars, steam exhaust would lead to radiator, where vapor could be condensed. On the dragster, vapor is released because the runs are short.



THIRTEEN MOVING PARTS—crankshaft, four valve rods, two valves, two pistons, two connecting rods, two rockers—are seen with casing removed. Engine weighs only 100 pounds.

Horsepower is limited only by the capacity and strength of the boiler; this model is as powerful as a large V-8. Walters estimates that his engine will run 300,000 miles with little or no attention.

Want to try steam power in your car? Walters will gladly make the conversion—for about \$2,000.

REAR SLICKS shown here are 8.00 x 15s. They'll soon be replaced by larger tires to handle the steam-powered car's tremendous torque.

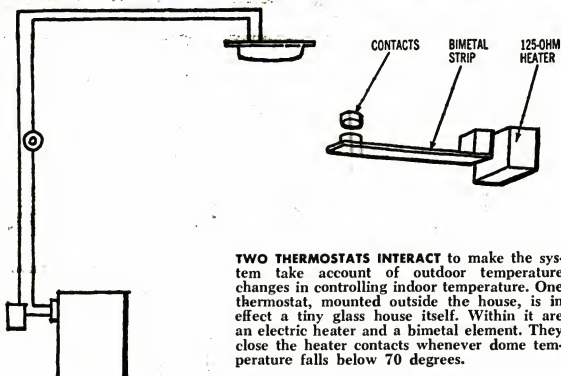


Railway car takes to street

Mounted on rubber-tired trucks, this tractor-towed railway motorcar is shown negotiating a street corner in the West

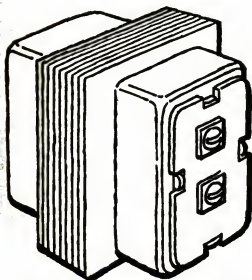
German city of Essen on its way to an exhibition hall. It's called an *Akkumulatorentriebswagen*, which means that it gets its power from accumulators—or what we'd call storage batteries.

How an Indoor-Outdoor

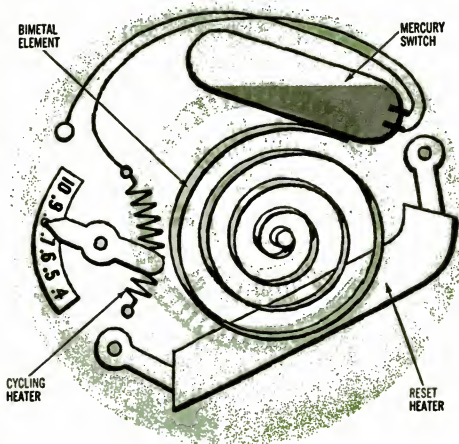


TWO THERMOSTATS INTERACT to make the system take account of outdoor temperature changes in controlling indoor temperature. One thermostat, mounted outside the house, is in effect a tiny glass house itself. Within it are an electric heater and a bimetal element. They close the heater contacts whenever dome temperature falls below 70 degrees.

INDOOR-OUTDOOR CONTROL requires a second (reset) heater, which is a resistor in series with the outdoor heater. When outdoor points are open, current flows through both, but because of relative resistances, heats only the indoor unit. When outdoor points close, they shut off the indoor heater.



STEP-DOWN TRANSFORMER connected to house power line provides 24-volt current for the control system. All wiring is hooked to a fiber panel that has connections for an extra resistor. The value of this is chosen to balance the system for mild, moderately cold, or severe climate to suit your particular area.



THE INDOOR THERMOSTAT has a spiral bimetallic element carrying a mercury switch that closes the furnace circuit. A small cycling heater gets current when the furnace runs; its trickle of heat biases the bimetal so that it shuts off the furnace a little before room temperature would. This compensates for overshoot, provides more frequent burner cycling and closer control.

Heating Control Works

AN IDEAL heating system should control house temperature so that occupants do not feel changes in the weather outdoors. But this cannot be achieved simply by holding indoor temperature steady.

Even the best indoor thermostats are late in responding to weather changes—after a drop in the mercury or sharp winds chill the walls. From this late start the furnace races to catch up with demand. Meanwhile, walls cool further, becoming heat-absorbing areas to which human bodies lose radiant heat, even though indoor air temperature is still near the thermostat setting.

Chilled by this “cold seventy” feeling, most people shove up the thermostat a degree or two.

In cold weather, when the furnace

runs constantly, so does the little cycling heater put inside modern thermostats to provide close control. But now it builds up enough heat to fool the bimetal, shutting off the furnace a little too soon. To beat this “droop” effect you have to raise the setting.

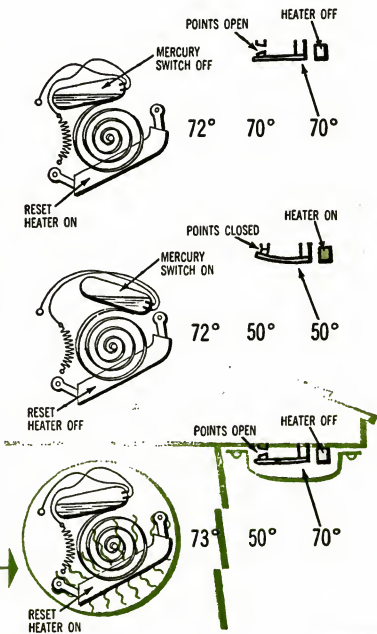
An indoor-outdoor control system puts another thermostat outside the house. Being more sensitive to weather changes than the house itself, it telegraphs the anticipated need for heat before occupants are aware of it. This eliminates both cold-seventy and droop effects by changing the control point (in effect, by turning up the thermostat). But unlike people, this system never forgets to turn it down again when the temperature turns mild. A single outdoor thermostat can control one or more indoor ones.

How the system responds to weather fluctuations

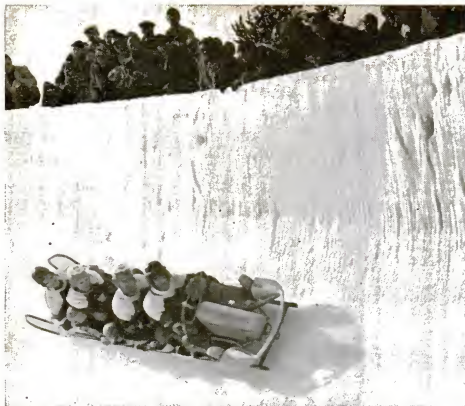
IN MILD TEMPERATURES of 70 degrees or more, the outdoor bimetal keeps the points open. Its heater carries too little current to affect this unit. The same current in the indoor reset heater makes that thermostat sense a slightly higher-than-true temperature. The control point at which the furnace starts is in this way kept close to the actual setting, such as 72 degrees.

WIND, COLD, OR BOTH affect the outdoor bimetal, as they eventually do house temperature. As outdoor contacts close, the heater begins warming the air inside the glass housing. Closed contacts also detour current around the indoor heater, so telling its thermostat that it's cold outside. This raises the control point so that the furnace starts putting out heat sooner.

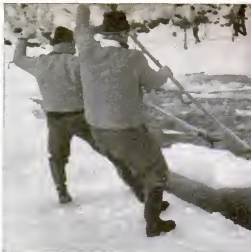
OUTDOOR CONTACTS OPEN when the heater has restored case temperature to 70. Indoor heater is once more on. But the outdoor case will cool fast or slowly depending on wind and weather, and repeat the cycle. How long outdoor contacts remain closed and heater out of circuit determines the shift of control point. This raises room temperature about one degree for every 20-degree drop in outdoor temperature.



Here's How a Run Is Built:



There are thrills in taking a banked curve on a bobsled run.



1. **BLOCKS OF SAWED ICE** are pulled out of a lake at the foot of the bobsled run.



5. **STACKED DIAGONALLY** at a curve, they are hammered in to even their surfaces.

What goes into a bobsled run

Championship bobsled runs don't just happen on a mountain. Carefully designed and engineered from the start, they have to be rebuilt each year. On the famous Olympic run at Garmisch, in the Bavarian Alps of Southern Germany, this maintenance is done by expert workmen who hold construction jobs in the summer.

The photographs at right show them at work on the run that was first built in 1936 for the German winter Olympics. The yearly rebuilding job takes 30 men from two to four weeks, depending on weather.



TRIGGER ON STOCK of firing tube sets missile on way. Impact opens shell and automatically inflates fabric raft.

Bazooka helps in water rescue

Fired from a bazooka-like tube, the projectile shown here inflates automatically on impact with water. It becomes a life raft that can support two persons for several hours.

The rescue missile is made of two aluminum half shells and is stuffed with compartmented fabric that inflates when they part. It was a design project developed by Marshall Corrazza Sr. and Thomas Dulin at the Philadelphia Museum College of Art.



PROJECTILE can be aimed accurately. As a water-rescue device, it overcomes distance limitations of life rings.



2. THEY ARE SLID up a ramp to the cutting table where they are resawed to desired size.



3. OLD ARMY JEEPS haul ice slabs up the mountain to the site where they will be used.



4. SMALL AND MEDIUM BLOCKS are delivered at the curves, large ones to the straightaways.



6. SLUSH IS TROWELED ON as "cement." A second layer of blocks is added for a facing.



7. STRAIGHTAWAYS ARE SHAPED with wooden forms. Snow is packed firmly along each side.



8. AT DAY'S END, workmen return home—some riding their shovels as convenient sleds.



Army's super battle tank

The Army has a new main battle tank now in production. The M-60, shown above undergoing tests at Aberdeen Proving Ground, Md., mounts a British-made 105-mm. gun capable of destroying any enemy armored vehicle known to exist. It has a cruising speed of 32 m.p.h. and a range of 250 miles. It will replace both the medium M-48 Patton and the heavy M-103. The light M-41 tank will continue in use for reconnaissance.



Taunus for '61

Not for sale in the U. S.—that's the tag line on the 1961 Taunus (German Ford). The new 17M, 200 pounds lighter, has a wind-tunnel-designed body that increases performance and economy. The 91.4- and 103.6-cu.-in., four-cylinder engines remain basically unchanged. Three- and four-speed fully synchronized transmissions are offered. The oval headlights have a larger reflecting surface and provide greater light intensity.



TORRENTS OF WATER from the Sahara's underground sea saved the town of Ouargla from drought. The well, tapping the sea 3,500 feet below, pumps water at a rate of 3,750 gallons an hour.

World's Biggest Desert to Bloom Again

A vast underground sea of fresh water is now being tapped to open up the incredibly rich treasures of the Sahara

By Joan Steen

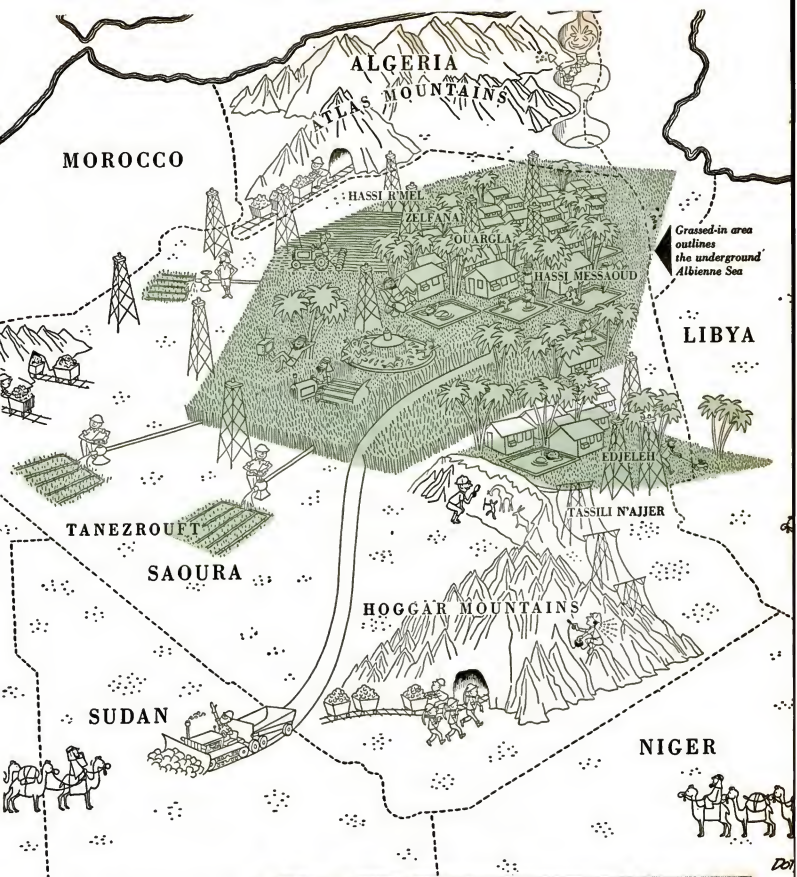
THE Sahara may bloom again. It did 6,000 years ago, lavishing an Eden's plenty upon the lost races that roamed its lush terrain. It can again. All it takes is water.

Water has now been found. A vast fresh sea of it lurks thousands of feet underground. Today, the first wells tapping that sea are pumping life back into the desert. For the water means crops can grow and man can live there again.



Water also means machines can operate. And they are. This time, men are after bigger stakes than date palms or olive groves. They want oil. And then coal, iron, gas. All these prizes of modern civilization lie waiting in the Sahara, which is not at all a worthless wasteland but a treasure-trove of minerals—perhaps the world's richest.

Mirage becomes reality. Water has already wrought an overnight change in the



OIL JETS OUT against a bleak desert backdrop at Edjeleh, near the Libyan border. Oil here lies only 1,500 feet below the surface, compared to 10,000 feet at other desert sites. Known reserves of the region run to about 150,000,000 tons.



Covering 2½ million square miles, the Sahara has fewer people per square mile than any place but the poles

town of Hassi Messaoud, south of Algeria, 435 miles from the Mediterranean. Once a flourishing oasis, it had withered to a water hole for camel trains as its well dried. Today, Hassi Messaoud is a booming oil town. Swimming pools cool 7,000 workers who live in houses air-conditioned by turbine-pumped, evaporating sprays of water. The residential quarter is set in gardens. Last winter, 50,000 shade trees were planted to anchor the sifting dunes.

Hassi Messaoud's never-failing pitcher is the Albienne Nappe, one of several huge natural storehouses of water beneath the Sahara, and the biggest. Imagine a sea the size of France soaked in a layer of earth 1,500 to 3,000 feet thick. Now bury that layer 1,000 to 4,000 feet underground. That's a rough idea.

Yet so uncharted were these waters that their discovery at Hassi Messaoud

came by chance. In 1956, French geologists were drilling for oil in the neighborhood. They expected to find it two miles down. They hit water at 3,500 feet. And cursed. But soon repented: Without that ready-at-hand water to cool their equipment, the oil-drilling operations themselves—since grown to 48 wells—would have been impossible.

Where does it come from? Engineers have now plotted the range of this fantastic subterranean sea. It covers 231,660 square miles, stretching from the Atlas Mountains, in the northwest, across into Libya and nearly as far south. But they're puzzled about its sources. So far, they've traced only one, in the southern Atlas. Here the Albienne surfaces over a wide area and funnels down the rain and run-offs from mountain catchments. A conservative estimate puts the annual intake here at 27 billion cubic feet. But that could be just a drop in the bucket.

Planners aren't sure how much water reaches the underground area every year, so they're being cautious about tapping it. Even so, the volume is breath-taking. At Zelfana, 100 miles northwest of Hassi Messaoud, the pressure of artesian wells from the Albienne is great enough to drive a small turbine to produce electricity. It may be the only power station of this sort in the world.

At nearby Ouargla, a single artesian well spouts 85 million cubic meters of water a year—3,750 gallons an hour. Here, too, water was the town's lifesaver.

Ten years ago, Ouargla's date palmeries were dying of thirst. Now, the well at Ouargla cataracts through sluices that carry water to all parts of the oasis. There's enough to leach the salt from waste areas as well as provide for hundreds of additional acres of palmeries. Even more exciting is the new agriculture: grain and vegetables now grow where once there was only parched sand.

Fossil soil. The truth is that the Sahara is not just one big ocean beach. There is that kind of sand—pure quartz. But in many places the quartz is mixed with limestone, grit, and marl—ingredients of a dormant soil. Wet it and it comes to life.



DEER AND ANTELOPE played on the grassy Saharan plains 5,500 years ago. This painting is one of many that archaeologists have found on cave walls in the Tassili Mountains.



NOT A MIRAGE, but a *real* oasis of date palms and cool shade at Taghit, Algeria. With water,

much of the desert could be reclaimed. Without it, the dunes keep growing and take over.



POWERFUL WATER PUMP works night and day to supply the needs of thirsty men and equipment in the oil-rich Edjeleh Mountains.



OIL ENGINEERS from the Sahara Oil Exploration and Exploitation Co. use a rotary table during testing operations at Edjeleh.

The desert is deceptive even deep at its heart, at a place Arabs call El Khela—the void. Here, in the Tanezrouft region, is a barrenness of pebbles and chips that the sun bakes to 130-degree heat. Yet those very pebbles and chips protect a fossil soil below. There, the pollen of tropical plants can still be found—memoirs of the Sahara's flowering past.

Geologically, a youngster. The Sahara is so young a desert that even more strik-

ing proof of its greener days has been found than pollens: pictures.

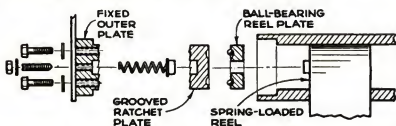
Tassili n'Ajjer, an abandoned pocket of plateaus 800 miles south of the Mediterranean, was the home of men who lived 10,000 years ago.

Those Stone Age hunters, and the races that came after them, left a rich store of paintings on the rock walls of their cave dwellings. These paintings would be re-

[\[Continued on page 232\]](#)



BELT IS SPRING-TENSIONED to allow the driver or a rider to reach for objects on the floor or elsewhere.



SUDDEN DECELERATION causes the inner plate to overrun slotted balls, forcing them against the ratchet. This jams its grooves into those in the fixed plate.

Safety belt permits bending

Inertial reels on this British safety harness allow free body movement during normal driving, but automatically lock in a collision or crash stop. A sudden jerk disengages one or more steel balls in the mechanism, wedges them in grooves in a ratchet plate, jams it shut, and prevents unwinding. Reels are spring-loaded so that belts are self-adjusting for length and retract when not in use. Shoulder and lap straps are joined in front by a quick-release buckle.



Jumbo crane hook

The big block and hook above weigh 10 tons—without counting the foreman riding them to direct loading onto a flatcar for shipment to GE's Schenectady, N. Y., plant. They will be used with a 300-ton crane to lift giant rotors and stators being made to turn turbogenerators for electric power. The block-and-hook assembly was built by Milwaukee Crane, Cudahy, Wis.



Umbrella service station

Twin plastic canopies protect motorists gassing up at a new service station in

Baton Rouge, La. Lighted up at night, they make a glowing translucent architectural display in addition to keeping drivers and attendants dry in a rain.



Metal men get many-metaled building

Every metal he could lay his hands on was used by R. Buckminster Fuller, well-known architect, in putting up this headquarters building for the American Society for Metals near Cleveland.

Aluminum was used for the lacelike

crown, structural steel for columns, stainless steel for stairways, bronze for door-knobs, brass for light fixtures, titanium for table legs, copper for screening. In the saucer under the dome are displayed ores from all over the world.



Blazing snow remover

Jets of flame shooting from the furnaces in front of this truck make short work of snow and ice on British highways and airfield runways. With its 12 oil burners fired, the Snow Locust can clear five miles of road an hour. The burners heat up to 1,200 degrees.



Camera shoots like gun

An ardent camera fan, Army Sgt. Ted Stiles built this special rifle stock that he attaches to his eight-mm. movie camera. With it, he "shoots" wildlife on film. During working hours he's a combat-development team member at Hunter Liggett Military Reservation in California.

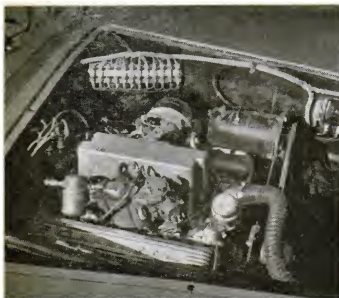


NECK-SNAPPING POWER makes the Bocar exhilarating to drive. Tires are 6.00 x 16 in front

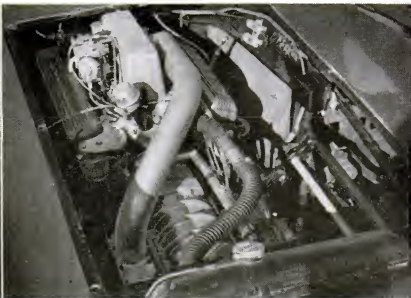
and 7.00 x 16 in rear, to handle torque and cornering loads. The windshield just barely shields.

Hotter Than Hot... The 200-m.p.h. Bocar

Piloting this \$8,700 sports car, which hits 60 from a standing start in four seconds, is an experience for the most jaded driver



ENGINE IS OFF CENTER by $1\frac{1}{4}$ inches to the right of center line, to balance the driver's weight. When driven to its limits, the car handles better solo than with a passenger aboard.



SUPERCHARGED VERSION uses a GMC 4-71 blower mounted forward of the modified Corvette V-8. In fine tune, this combination is rated by Carnes as delivering 500 hp. at 8,500 r.p.m.

By Alex Markovich

THE vicious rap of a highly tuned engine echoes down your quiet street, building up to a penetrating crescendo. Before the car stops in your driveway, you are out of the door. At last your brand-new Bocar—let's daydream a little—is being delivered.

Curious faces gape from nearby windows and the neighborhood kids come pounding up. There in your drive is a sinuous plastic-bodied roadster, less than a yard high, gleaming with a 30-coat lacquer finish. The factory man who has ferried it to you from its Colorado birthplace hands over the keys and ownership papers.

You reach inside, groping for the unfamiliar door latch. Climbing in takes a bit of contortion, but once you're settled in the deep, foam-padded bucket seat, you feel right at home. So you should, too. For at the factory in Denver six weeks before, when you pressed that check for \$8,700 or more on them, they *measured* you for your new car. Seat width, windshield height, wheel placement, and pedal spacing were all tailored just for you.

At the factory, a small plant on Denver's west side, you'd met the proprietor, Bob Carnes, whose product is a combination of the first letters of his names. A genial young engineer and race driver, he likes U.S. rather than imported machinery. He thinks that there's a market for a high-priced vehicle that is just



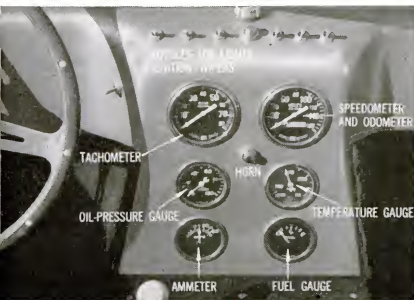
PARK IT at the shopping center and it will draw a crowd of car critics. The one-piece fiber-glass body encloses a light but strong cage frame. Car has little parking protection—no bumpers.

ENTRY OR EXIT call for a tricky wiggle. Put left hand on car side and right on the transmission hump; give a convulsive heave; and then you're in—or out.



docile enough for street wear—and hairy enough for competition.

The first model emerged from Carnes' garage in 1957. In 1958 he built three. This year, working from a new, well-equipped plant, he hopes to turn out more than 200. But production is a problem, because Carnes is a perfectionist. Everyone at Bocar must be an expert mechanic, welder, body man, and painter.

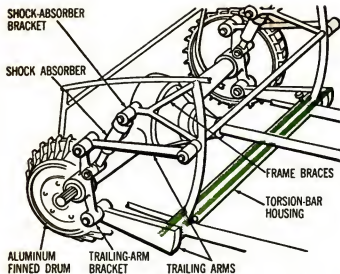


BIG GAUGES can be scanned at a glance if they have to be. In hot weather in heavy traffic you keep a wary eye on the temperature needle; no power-stealing fan cools the radiator.

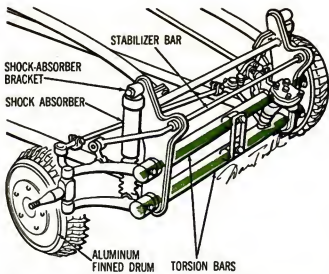


NO-NONSENSE COCKPIT isn't Spartan, and shows high quality in detailing. Shift lever is tilted way forward. Driver and passenger have excellent leg room alongside the power plant.

CONTINUED



INDEPENDENT FRONT SUSPENSION, similar to the VW's, always keeps Bocar's front wheels on an even plane, thus giving better bite on rough surfaces than does a solid front axle.



The live rear axle has twin trailing arms. Torsion bars are adjustable all around with screw bolts; Road clearance can be set anywhere from three to nine inches.

The shakedown run. Back in the driveway at home, you flick a toggle and the fuel pump begins ticking. Another switch turns on the ignition. You kick the accelerator and press a button. The engine—a modified Corvette mill—growls like a jungle cat and subsides to a loping idle that hints of the radical cam that tickles the valves. The fuel-injection intake hisses venomously.

You engage the crisp, four-speed synchromized Corvette gearbox in first and tromp on the gas. The car screeches forward, trailing two black streaks of burnt rubber. Careful—314 horses and a mere 2,000-pound "wet" weight make a potent combination.

You shift into second, and again the car surges ahead. It's hard to tell that the clutch is hydraulically operated; an oversize line from master to slave cyl-

inder allows instantaneous release. The ride is firm but, surprisingly, not as stiff as in a number of foreign "boulevard" machines. Steering is fast ($3\frac{1}{4}$ turns lock-to-lock) and precise, and, thanks to a nearly 50-50 weight distribution, generally neutral.

Stares and dares. Driving down the main drag can be nerve-wracking. If you dislike being conspicuous, the Bocar definitely isn't for you. Motorists and passersby stare, shout, and point. T-shirted teen-agers in souped flathead Fords and elderly businessmen in late Cadillacs alike try to egg you on to drag. Visions of splintered fiber-glass spring up each time the driver behind stops too close to the car's bumperless rear. You have to keep an eagle eye on the dash instrumentation, particularly the temperature

[Continued on page 228]



LITTLE TRUNK SPACE remains once spare goes in. Optional 38-gallon metal gas tank weighs 54 pounds, but keeps the gas safely where it belongs. Ten Dzus fasteners secure the trunk cover.



CANTED QUADS allow a smooth, rounded fender contour. Shrouding forces all air entering the scoop to pass through radiator. A vent in the middle of the hood relieves pressure and acts as a spoiler to break the vacuum over the hood.



FOR COMPETITION DRIVING, chromed, rear-mounted muffler unbolts easily. Straight exhausts cause minimal backpressure. Nicely detailed rear shows recessed tail lights and license plate.



INFRARED-BEAM PHONE is aimed with a rifle-type sight on top and held by a pistol grip.



TOP LENS receives the talking beam; the lower one sends.

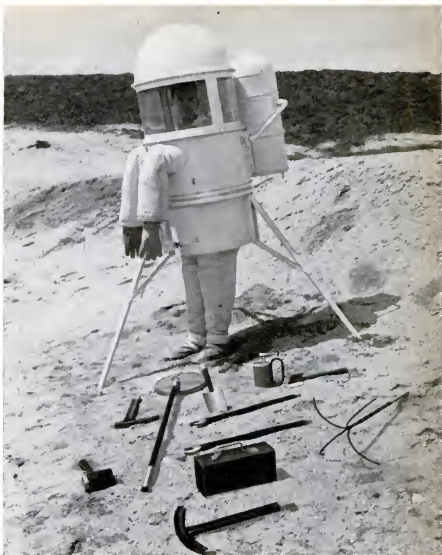
Now you can talk via invisible light

This is a civilian version of the infrared-beam telephone—no wires, no radio waves—used by the Army and Navy. You talk into a microphone in the back. Its signal varies infrared rays aimed at a receiving unit. A detector there converts the infrared beam into an electrical signal for a telephone-type receiver.

The Infraphone can communicate over 500 yards, works even through closed windows—or around corners, with the help of mirrors. Each unit costs \$20 and runs on flashlight batteries. Infrared Industries, Waltham, Mass., makes it.

Ship gets long, light reach

A 256-foot aluminum boom has been added to the Great Lakes coal and limestone carrier J. R. Sensibar. It is 60 feet longer but 25 tons lighter than the steel boom it replaces. A conveyor belt, running its entire length, unloads 4,000 tons of cargo an hour.

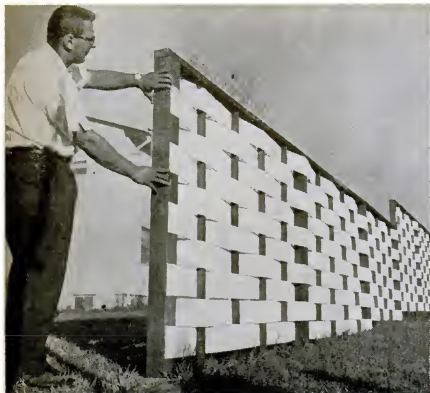


Lunar suit for space explorer

A spaceman could use this suit while exploring the moon—and even rest in it if he's on a long hike. It is equipped with retractable tripod legs that will hold it up off the ground and a built-in seat that he can curl up on while easing his tired feet.

The suit is made of aluminum, has a circular plastic window and nylon-coated neoprene arms and legs. The tank strapped to the back supplies oxygen and contains a carbon-dioxide absorbent. The controls are inside the cylinder along with shelves of food for lengthy trips. Tools the wearer could use would be similar to those lying on the ground. The suit was built by Republic Aviation, weighs 120 pounds, which on the low-gravity Moon would be equivalent to 20 on Earth.





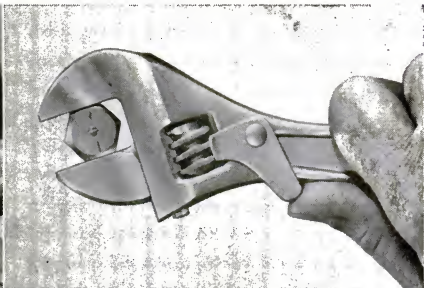
Plastic Fence You Can Build

Erect a frame of four-by-four posts topped with two-by-fours, insert one-by-threes at intervals, and you can weave on a saran-plastic webbing that will outlast its supports. The webbing is six inches wide and comes in different col-

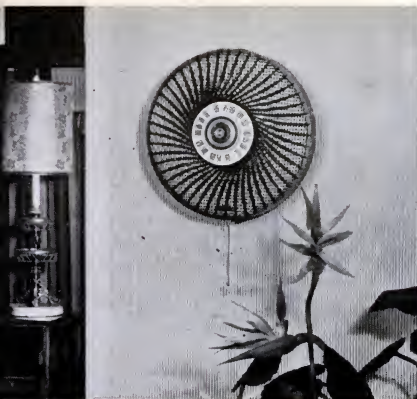
ors. Each 400-foot roll is enough for 57 feet of four-foot-high fence, 44 feet five feet high, or 36 feet six feet high. Staple the ends and finish with furring. About \$60 a roll. Weblite, Inc., 24 Jericho Tpk., Mineola, N.Y.



PHONE AMPLIFIER lets you talk and hear over a telephone 10 feet away, leaving both hands free for other tasks. Transistorized Speak-Up operates on a nine-volt battery, requires no connection. You simply rest the receiver in its cradle. \$39.95. ORCOA, 59 Hempstead Garden Dr., West Hempstead, N.Y.



WRENCH-JAW LOCK is fixed at a desired setting by a flick of your thumb, won't slip, eliminates resetting for same-width nuts and bolts. Parts are interchangeable with standard wrenches of the same size. Lengths range from 4 to 12 inches at \$2.75 to \$6.04. Utica Drop Forge & Tool Div., Utica, N.Y.



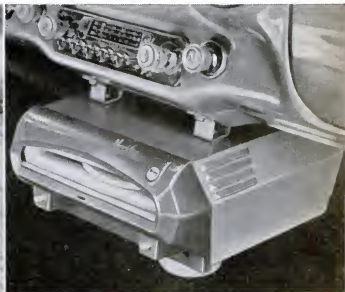
WALL RADIO has a seven-transistor superheterodyne circuit, two three-inch speakers, and operates up to 500 hours on four D-cell batteries. Toshiba radio is available in black or white finish with gold trim. Complete with batteries and mounting bracket, \$69.95. Transistor World Corp., 52 Broadway, NYC.



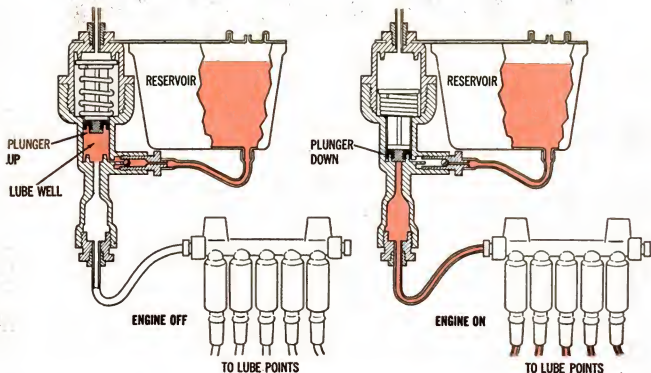
SELF-FEEDING ROLLER puts paint on a wall without splashing. Flow is from inside the roller to the surface through a hose attached to a shoulder-strap container. Thickness of coating is controlled by pressure on the roller. With two foam-plastic rollers, \$5. Wallmaster Co., 1232 Milwaukee Ave., Chicago.



PLASTIC-CLAD STEEL TAPE has a polyester film to resist abrasion and solvents, preserve legibility. It's said to outwear three regular blades. With 1/2-inch blade in 6-, 8-, 10-, and 12-foot lengths; 3/4-inch in 10- and 12-foot lengths: \$1.49 to \$2.98. The Stanley Works, 111 Elm St., New Britain, Conn.



AUTO HI-FI PLAYER requires only one hand to change records. Push a 45-r.p.m. disk into the slot and the rest is automatic, even to the record sliding out when finished. Auto Mignon uses car radio as amplifier, works on 6- or 12-volt battery. North American Philips Co., 230 Duffy Ave., Hicksville, N.Y.



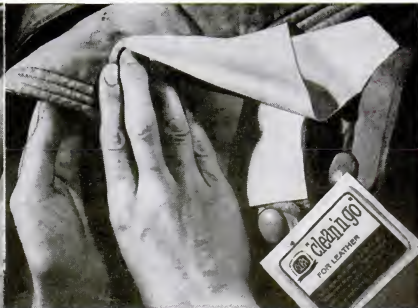
Automatic Car-Lube System

With this device mounted under the hood, metered lubricant is fed to steering and front-end suspension fittings every time you start your engine. It works on oil pressure transmitted to a spring-loaded plunger when the engine is turned on. This pushes lube from a well

through a manifold and lines clipped to the fittings. When you stop the engine, the well is refilled from a reservoir. Only servicing necessary is to add lube to the reservoir when it is empty. \$25 to \$50, depending on number of fittings required. Walker Mfg. Co., Racine, Wis.



WINDSHIELD SPRAY melts off ice and snow when you apply it from an aerosol can. A spraying before a storm will keep your windshield clear for up to 12 hours. Free O' Ice will also unstick frozen locks and iced-up hinges. A 10-ounce can: \$1.19. Consolidated Research & Mfg. Corp., New Haven, Conn.



LEATHER CLEANER is a specially treated tissue with which you can wipe surface dirt and many spots off leather gloves, clothing, luggage, and upholstery. Each tissue can be used several times. A package of three costs \$1. Suede and Leather Refinishers of America, 75 E. Wacker Dr., Chicago.

FIRE ESCAPE is permanently attached to an outside masonry wall or the wooden siding of your house near an upper-story window from which it can be reached in an emergency. It's made of aluminum and, folded shut, looks like a downspout. When you push a button inside the house, it opens out and becomes a sturdy ladder that will hold you and three or four other adults at the same time. It can't be opened from the outside. Price, \$200 up, depending on its height. Coolman Life Ladder, Inc., 2812 Book Tower, Detroit.



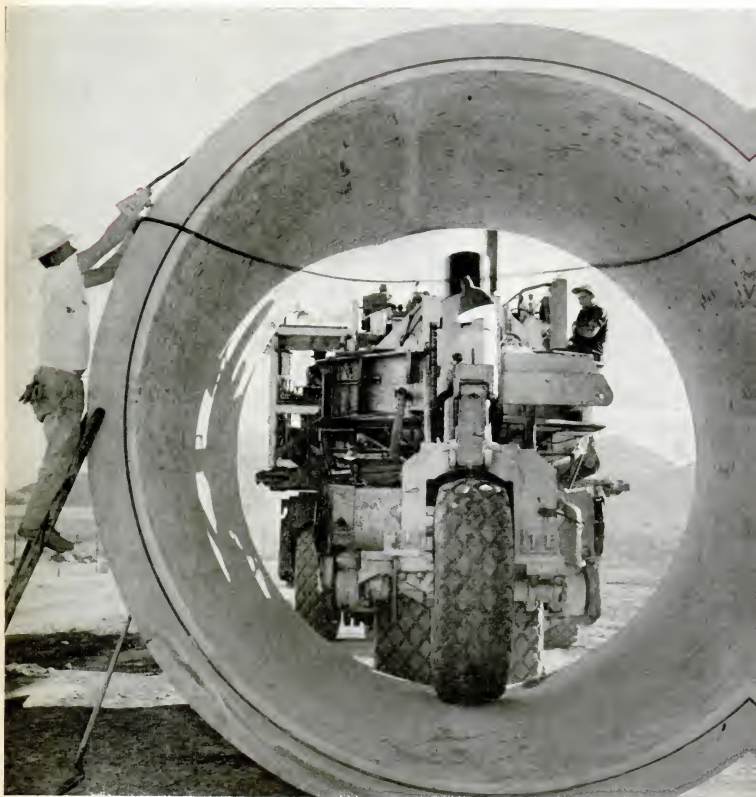
CAR-TOP RACK is designed with rails and stanchions of aluminum alloy to fit all station wagons, including compacts. It comes with fittings and resilient pads, can be mounted in an hour. The 58-inch model shown is \$44.50; a 72-inch one sells for \$83.20. Canell Co., 57 S. State St., Hackensack, N. J.

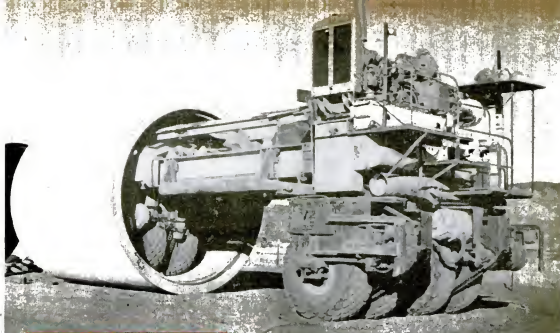


WEATHERSTRIP KIT contains screw-on jamb and heading strips of solid aluminum having a vinyl insert with "fingers" that seal the door edges. Included is an aluminum-and-vinyl door shoe that carries off rain. Corners are pre-coped. \$6.75 per door. Pemko Mfg Co., 5755 Landregan St., Emeryville, Calif.

Strange Truck Crawls Inside Pipe to Haul It

No ordinary vehicle could wrestle the ungainly aqueduct pipes into line. So engineers invented one—the Pipemobile

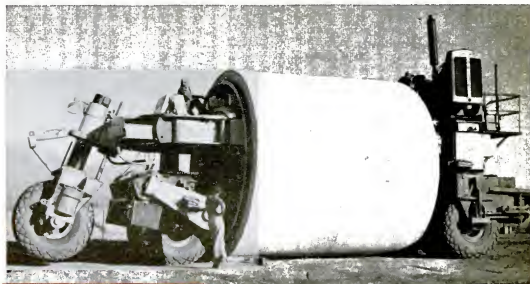




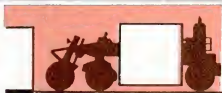
PIPEMOBILE CRAWLS INTO A SECTION by lifting its leading front wheel hydraulically and planting it inside the pipe. Pushing down on this single wheel, through a telescoping arm, lifts the machine's front end so the pair of wheels following can roll into the pipe.

THIS extraordinary machine was designed to do just one job: crawl into a huge section of concrete pipe, hump its back and walk off with a 66-ton load. Engineers constructing a 13-foot-diameter aqueduct from the Colorado River to the Metropolitan Los Angeles area needed a single machine with the brawn to haul such pipe sections around, and with the delicate control to match them in leakproof joints. Pipemobile, made by American Pipe & Construction Co., was the result of their specifications.

A 300-hp. diesel high on a rear platform drives the generator that powers the machine and its hydraulic equipment. All controls except steering are at the rear. An operator at these controls gets instructions from the driver by phone. Pipemobile has its own floodlights to illuminate the inside of the pipe.



WHEELS OUT THE OTHER SIDE, the machine hunches its back and lifts 66 tons of concrete pipe. A huge hydraulic piston below the driver raises the three steel beams on which pipe rests. Phone line connects driver with another man on the rear platform.



STEERED BY PUSHBUTTONS, the Pipemobile rumbles into the excavation and heads for the pipeline's open end. Friction prevents the pipe section from sliding forward on the machine,

except on steepest downgrades. Then a stop above the driver's head can be raised hydraulically. A thin, round gasket of rubber has been fitted to one end of the new section.



AFTER CLIMBING INTO THE PIPELINE with its front wheels, Pipemobile jiggles the new section until it lines up exactly with those in place. On grades up to 20 percent, the machine can crawl out unaided. Steeper ones call for help from a bulldozer hooked to the rear.

HERE ARE EXAMPLES
OF PROBLEMS YOU CAN
SOLVE IN YOUR HEAD

$$5 \times 48 = 240 \quad 3163 + 234 = 3397$$

$$624 - 348 = 276 \quad 9 \times 89 = 801$$

$$35 \times 28\frac{1}{2} = \$9.80 \quad 135 \div 15 = 9$$

$$7847 + 342 = 8189$$

$$18 \times 28 = 504$$

$$39 \times \$$$

$$55$$

$$14$$

$$8$$

$$16$$

$$11 \times$$

$$14 \times 35$$

$$18 \times 54\frac{1}{2}$$

$$84 + 99 = 183 \quad 6420 - 3865 = 5$$

$$420 \div 35 = 12 \quad 17 \times 27 = 459$$

$$136 + 68 = 204 \quad 65 \times 65 = 4225$$

$$51\% \text{ of } \$82.30 = \$41.97 \quad 45 \times$$

$$1200 \div 75 = 16 \quad 6 \times 34 = 204$$

$$7 \times 128 = 896 \quad 613 + 324 = 937$$

$$56 \div 14 = 4 \quad 11 \times 43 = 473 \quad 39$$

$$45 \times 78\frac{1}{2} = \$35.10 \quad 32\frac{1}{2} \times 140$$

$$128 \div 16 = 8 \quad 944 + 361 = 1305$$

$$\$12.66 + \$5.48 = \$18.14 \quad 17 \times 18$$

$$16 \times 23 = 368 \quad 735 + 152 = 887$$

Popular
Science
Monthly

BOOK DIGEST

High-Speed Math

You can be a wizard at figures by taking advantage of this treasury of mental and written short cuts - a PS book condensation complete in this issue*

By LESTER MEYERS

*Abridged and revised from the book, *High-Speed Math*, by Lester Meyers (D. Van Nostrand Co., Inc., Princeton, N. J., \$6.95); with textual changes and interpolations, as required for condensation, by the editors of POPULAR SCIENCE MONTHLY.

KNOWING short cuts in mathematics can be profitable and pleasurable. In a conversation... at a conference... on a train... in an airplane... in bed with the lights out... it is a decided advantage to be able to make a quick computation without paper and pencil.

The purpose of this book is to show how a wide variety of problems can be computed quickly and mentally—or with a minimum of paperwork—and how errors

can be virtually eliminated. Readers will discover, in the wealth of ideas presented here, some of the most important “secrets” of speed and accuracy in business mathematics.

Nothing more is needed than a knowledge of simple arithmetic to sail through this book.

It promises a satisfying adventure of mental excursions to a world where computations become fun instead of work.

SHORT CUTS IN MULTIPLICATION

Unconventionally, multiplication is considered first in this book, since these problems are the kind most frequently encountered in business. There is a short cut for virtually every multiplication problem.

The Magic of the Tens

TO MULTIPLY a number by 10, you need only put a zero after the last figure; or, if there is a decimal point, move it one place to the right. Thus $10 \times 47 = 470$, and $10 \times 38.9 = 389$.

This may seem elementary, and it is. Yet many fail to take advantage of it, in multiplying by other numbers.

Multiplying by 5. Let us begin with a simple example: 5×48 . The average person would multiply 8 by 5; set down a zero; carry 4; multiply the 4 in 48 by 5; and add a 4 to the product.

Actually you could do this problem in your head. Five is half of 10. Why not, then, multiply 48 by 10, and divide the result by 2? You get the answer, 240, in the twinkling of an eye.

No matter how many figures a number contains, you can compute it quickly by 5 this way, without having to write down anything more than the answer.

Multiplying by 9. It is possible to make many computations rapidly and easily, often mentally, by multiplying by 10 or a multiple of 10, and adding or subtracting a small partial product. Multiplying by 9 is an example:

Nine is $10 - 1$. So 9×89 is equivalent to 890 (10×89), less 89 (taken once). Mentally subtracting 89 from 890, you know in a few brief seconds that the answer is 801.

To multiply 8754 by 9:

$$\begin{array}{r} 10 \times 8754 = 87540 \\ - 1 \times 8754 = - 8754 \\ \hline 9 \times 8754 = 78786 \end{array}$$

Only the three numbers at the right—the two partial products and the answer—need be written down. In this example and others to follow, the part at the left is just to explain the procedure.

Multiplying by 15. Ten times a number, plus 5 times the number, equals 15 times the number. To multiply 782 by 15:

$$\begin{array}{r} 10 \times 782 = 7820 \\ + 5 \times 782 \left(\frac{1}{2} \text{ of } 7820 \right) = +3910 \\ \hline 15 \times 782 = 11730 \end{array}$$

Multiplying by 25, 50, and 75. Just as the number 10 works short-cut magic, so do 100 and other powers of 10.

To multiply by 25, multiply by 100 and divide the result by 4. For example:

$$25 \times 36 = \frac{1}{4} \text{ of } 3600 = 900$$

To multiply by 50, multiply by 100 and divide the result by 2. Thus:

$$50 \times 38 \text{ cents} = \frac{1}{2} \text{ of } \$38 = \$19.00$$

To multiply by 75, simply add the results of multiplying by 50 and by 25.

Multiplying by numbers just below 100 and 1000. The method illustrated is obviously the only one to use:

Example: Multiply 147 by 99. Solution: $99 = 100 - 1$. Therefore, multiply 147 by 100, and subtract 147 taken once:

$$\begin{array}{r} 100 \times 147 = 14700 \\ - 1 \times 147 = - 147 \\ \hline 99 \times 147 = 14553 \end{array}$$

Example: Multiply 216 by 98. Solution: $98 = 100 - 2$.

$$\begin{array}{r} 100 \times 216 = 21600 \\ - 2 \times 216 = - 432 \\ \hline 98 \times 216 = 21168 \end{array}$$

Similarly, change 97 to $100 - 3$, and 96 to $100 - 4$. The multiplier 999 likewise becomes $1000 - 1$, and so on.

TRY-IT-YOURSELF PROBLEMS

These can be done mentally:

Without putting pencil to paper, read from left to right the product of 5 times \$648.32.

Ans. \$3,241.60

One bushel equals 64 dry pints. How many dry pints are there in 5 bushels?

Ans. 320 dry pints

What would be the weight of 340 bales of Ceylon cinnamon featherings, averaging 99 pounds to a bale?

Ans. 33,660 pounds

For these, use pencil and paper:

How many square feet are there in 260 square yards? (1 sq. yd. = 9 sq. ft.)

Ans. 2,340 square feet

A girl can produce 187 machinery parts in one day; how many can she, in 9 days?

Ans. 1,683

What is the cost of a rug of 15 square yards quoted at \$4.62 a square yard?

Ans. \$69.30

What would a dry-goods dealer receive for 97 yards of cloth, at an average price of \$3.40 a yard?

Ans. \$329.80

.....

The introductory miscellany of short cuts in the chapter above applied two different and valuable techniques, which it is now time to look at more closely: the Breakdown Method, and the "Double-and-Halve" Method.

The Breakdown Method

THIS procedure splits up a number to be used as a multiplier into (1) a nearby round number, either smaller or larger than the given multiplier; and (2) the number by which (1) is less, or more, than the given multiplier.

Multiplying in turn by (1) and (2), we add or subtract the products to get the answer.

It was this method that we used when we replaced the multiplier 9 with $10 - 1$, and 15 with $10 + 5$. Now we shall consider some of the ramifications of the Breakdown Method.

How to multiply quickly by miscellaneous two-figure numbers

Here are examples of short cuts for multiplying by a variety of numbers:

26. Breakdown: $25 + 1$. To multiply \$3.60 by 26:

$$\begin{array}{r} 25 \times \$3.60 \text{ (}\frac{1}{4} \text{ of } \$360) = \$90.00 \\ + 1 \times 3.60 = + 3.60 \\ \hline 26 \times \$3.60 = \$93.60 \end{array}$$

35. Breakdown: $25 + 10$. To multiply 28 cents by 35:

$$\begin{array}{r} 25 \times \$0.28 \text{ (}\frac{1}{4} \text{ of } \$28) = \$7.00 \\ + 10 \times .28 = + 2.80 \\ \hline 35 \times \$0.28 = \$9.80 \end{array}$$

Problems like those above can be worked mentally in a few seconds.

39. Breakdown: $40 - 1$. To multiply 73 by 39:

$$\begin{array}{r} 40 \times 73 = 2920 \\ - 1 \times 73 = - 73 \\ \hline 39 \times 73 = 2847 \end{array}$$

49. Breakdown: 50 (half of 100) $- 1$. Then, same procedure as for 39.

51, 52. Breakdowns: $50 + 1$; $50 + 2$. To multiply 38 cents by 52:

$$\begin{array}{r} 50 \times \$0.38 \text{ (}\frac{1}{2} \text{ of } \$38) = \$19.00 \\ + 2 \times .38 = + .76 \\ \hline 52 \times \$0.38 = \$19.76 \end{array}$$

59. Breakdown: $60 - 1$. Then, same procedure as for 39.

76. Breakdown: $75 + 1$; using $\frac{3}{4}$ of 100, or $50 + 25$, for 75. To multiply 44 cents by 76:

$$\begin{array}{r} 75 \times \$0.44 \text{ (}\frac{3}{4} \text{ of } \$44) = \$33.00 \\ + 1 \times .44 = + .44 \\ \hline 76 \times \$0.44 = \$33.44 \end{array}$$

BOOK DIGEST : High-Speed Math

79. Breakdown: $100 - 21$. To multiply 347 by 79:

$$\begin{array}{r} 100 \times 347 = 34700 \\ - \{ \begin{array}{l} 20 \times 347 = 6940 \\ 1 \times 347 = 347 \end{array} \\ \hline 79 \times 347 = 27413 \end{array}$$

89. Breakdown: $100 - 11$. Then, same procedure as for 79. (Many numbers can be multiplied by 11 in a single step, at sight, a later chapter will show.)

Some of these short cuts illustrate a principle worth noting:

It is easier to multiply by a low digit like 2, 3, or 4, than by a high digit like 7, 8, or 9. Of course, multiplying by 1 (or 10, or 100) is the easiest of all.

.....

As for the *multiples of 10* (the starting points of many of the preceding breakdowns, and of more to come):

Multiplying by 20, 30, and 40, of course, amounts to no more than multiplying by the low and easy digits 2, 3, and 4, and adding a zero.

Breaking down 60, 70, or 80 may become worthwhile if it serves as a stepping-stone to another number. Alone, 60, 70, and 80 would be used as directly as 6, 7, and 8.

The still-higher number 90, by analogy with 9, regularly becomes $100 - 10$.

How to multiply quickly by 18, 27, 36, and other multiples of 9

Eighteen is the equivalent of 20, minus $1/10$ of 20. To multiply 18×28 :

$$\begin{array}{r} 20 \times 28 = 560 \\ - 2 \times 28 (1/10 \text{ of } 560) = 56 \\ \hline 18 \times 28 = 504 \end{array}$$

See how simple this becomes—so effortless that you can do it in your head. It is much easier to take $1/10$ of a number than to multiply by any digit, particularly by 7, 8, or 9.

The same short cut serves for other multiples of 9: You change 27 to 30, 36 to 40, 45 to 50, 54 to 60, and so on; multiply by the raised number; and, in each case, subtract $1/10$ of the result. For example, to multiply 45×34 :

$$\begin{array}{r} 50 \times 34 (1/2 \text{ of } 3400) = 1700 \\ - 5 \times 34 (1/10 \text{ of } 1700) = 170 \\ \hline 45 \times 34 = 1530 \end{array}$$

How to multiply quickly by 38, 57, and other multiples of numbers ending in 9

When many other numbers are raised to a multiple of 10—as, 38 to 40, or 57 to 60—you will find that the new number is a simple multiple of the one added. There is a time-saving advantage in always being on the lookout for ideal combinations of figures like these.

Raising 38 by 2 changes it to 40, and 2 is $1/20$ of 40. So a short way of multiplying by 38 will be to multiply by 40, and subtract $1/20$ of the result. To multiply 38×28 :

$$\begin{array}{r} 40 \times 28 = 1120 \\ - 2 \times 28 (1/20 \text{ of } 1120) = 56 \\ \hline 38 \times 28 = 1064 \end{array}$$

Likewise, to give just a few examples of other numbers of this large group:

$$\begin{array}{ll} 57 = 60 - 3 (1/20 \text{ of } 60) \\ 78 = 80 - 2 (1/40 \text{ of } 80) \\ 87 = 90 - 3 (1/30 \text{ of } 90) \\ 114 = 120 - 6 (1/20 \text{ of } 120) \\ 116 = 120 - 4 (1/30 \text{ of } 120) \\ 117 = 120 - 3 (1/40 \text{ of } 120) \\ 118 = 120 - 2 (1/60 \text{ of } 120) \\ 133 = 140 - 7 (1/20 \text{ of } 140) \end{array}$$

In multiplying by three-digit numbers of this kind, a reverse procedure reduces the three steps in multiplying to two:

To multiply 237×429 , change 237 to $240 - 3$ ($1/80$ of 240). Compute the product of 240×429 *after*, and write it *above*, the product of 3×429 :

$$\begin{array}{r} \text{Second step:} \\ 240 \times 429 (80 \times 1287) = 102960 \\ \text{First step:} \\ - 3 \times 429 = 1287 \\ \hline 237 \times 429 = 101673 \end{array}$$

As could be recognized from the ratios of their breakdowns, these numbers owe their helpful properties to the fact that they are multiples of 19, of 29, of 39, and of other numbers ending in 9.

How to multiply quickly by 84, 123, and other multiples of numbers ending in 1

Numbers of this large group are worth recognizing, as is easy at a glance: The last digit (any from 2 to 9) is a simple fraction of the other digit, as in 84; or of the other pair of digits, as in 123 or 186. So the rest of the number is a convenient multiple of it. In 84, 80 is 20×4 ; in 123, 120 is 40×3 ; in 186, 180 is 30×6 .

The way to break down these numbers, then, is to decrease them to a lower multiple of 10. To multiply 84×234 :

$$\begin{array}{rcl} 4 \times 234 & = & 936 \\ + 80 \times 234 (20 \times 936) & = & + 18720 \\ \hline 84 \times 234 & = & 19656 \end{array}$$

This commences to look somewhat like conventional multiplication—which, when you stop to think about it, also “breaks down” 84 into $4 + 80$, by using the digits 4 and 8 in turn. Note that our way is simpler, however. For 4 and the high digit 8, we have substituted an easier pair, 4 and a low 2. (It was to do this, that the smaller term was computed first.)

We have a further advantage when we come to a three-digit number of this kind, like 186. Our way reduces the rows of figures to be added, from three to two. To multiply 186×368 :

$$\begin{array}{rcl} 6 \times 368 & = & 2208 \\ + 180 \times 368 (30 \times 2208) & = & + 66240 \\ \hline 186 \times 368 & = & 68448 \end{array}$$

Numbers of this type are multiples of 21, of 31, of 41, and of other numbers ending in 1. Their “plus-type” breakdowns are the counterparts of the “minus-type” breakdowns we used for multiples of numbers ending in 9.

The obvious possibility of breaking down 21 itself to $20 + 1$, 31 to $30 + 1$, or 41 to $40 + 1$ has gone unmentioned, because that is substantially the way we multiply by them conventionally; here, we are concerned only with short cuts. (Similarly outside our scope are many other conventional “breakdowns,” as of 11 to $10 + 1$, 12 to $10 + 2$, 23 to $20 + 3$.)

How to extend these short cuts to many more numbers

You break down 135 just as you do 35, with 100 added: $100 + 25 + 10$. The num-

ber 497, after the fashion of 97, becomes $500 - 3$. Similarly, short cuts for other numbers already given can be extended to numbers that are higher by 100, or several hundred, or 1000.

Numbers ending in zeros, of course, break down just like their counterparts without the zeros: 180, as 200, less $1/10$; 4980, as $5000 - 20$.

And, should a prospective multiplier just miss ideally fitting one of these short cuts, go right ahead and use the short cut anyway—simply tacking the “leftover” term on the end of the breakdown. You will find examples below.

How to break down miscellaneous numbers of three figures or more

While it would be impossible here to tell in detail how to deal with every number amenable to the Breakdown Method, the following sample of recommended breakdowns should serve as a guide:

$$128 = 100 + 25 + 3$$

$$165 = 100 + 50 + 15 \text{ (Multiply by 100 + 50; add } 1/10 \text{ of result)}$$

$$185 = 200 - 15$$

$$288 = 300 - 12 \text{ (Multiply by 300; subtract } 4/100 \text{ of result)}$$

$$342 = 300 + 30 + 12 \text{ (Multiply by 300; add } 1/10, \text{ and } 4/100, \text{ of result)}$$

$$389 = 400 - 11$$

$$436 = 400 + 40 - 4 \text{ (Multiply by 400; add } 1/10, \text{ and subtract } 1/100, \text{ of result)}$$

$$576 = 600 - 24 \text{ (Multiply by 600; subtract } 4/100 \text{ of result)}$$

$$1150 = 1000 + 100 + 50$$

$$1278 = 1000 + 250 + 25 + 3$$

$$2483 = 2000 + 400 (2/10 \text{ of } 2000) + 80 (2/10 \text{ of } 400) + 3$$

$$3267 = 3000 + 300 - 33 \text{ (Multiply by 3000; add } 1/10 \text{ of result; subtract } 1/100 \text{ of new result)}$$

TRY-IT-YOURSELF PROBLEMS

Mental:

Compute the amount of wages due a workman for 39 hours at \$1.24 an hour.

Ans. \$48.36

What is 49 pounds of antimony worth, to the nearest cent, at a market quotation of \$0.1612 per pound?

Ans. \$7.90

Find 51% of \$82.30, to the nearest cent.

Ans. \$41.97

How much is 45 times 78 cents?

Ans. \$35.10

Written:

How many nails, of which 876 weigh a pound, will there be in a keg with a net weight of 79 pounds? **Ans. 69,204**

Compute the weight of 172 cubic feet of dry elm wood, averaging 35 pounds per cubic foot. **Ans. 6,020 pounds**

The net weight of a bottle of a cosmetic product is 18 ounces. How many ounces will be needed to fill one gross of these bottles? **Ans. 2,592 ounces**

A contractor completes a job in 28 working days. His labor cost was \$18 a day. What did he pay out in labor? **Ans. \$504**

A manufacturer receives an order for 536 boxes, each requiring 27 square feet of lumber. How much lumber will be needed? **Ans. 14,472 square feet**

At 36 cents per yard, what will 734 yards of plastic film cost? **Ans. \$264.24**

A bushel basket of plums weighs 57 pounds. How much will 73 baskets weigh? **Ans. 4,161 pounds**

Compute the number of yards in 84 pounds of typewriter fabric, of which there are 5.06 yards to the pound.

Ans. 425.04 yards

The "Double-and-Halve" Method

ONE of the most helpful short cuts may be called the "Double-and-Halve" Method. It is a simple little trick, and the wonder is that so many businessmen with a mathematical background never think of using it.

Its principle is that when the two numbers in a multiplication problem are multiplied and divided, respectively, by the same value, the product is unchanged.

Examples will show how many problems can easily be computed mentally, and others with a minimum of pencil-and-paper work, by this uncommonly used method.

Multiplying mentally by 14 and other low, two-figure even numbers

To compute 14×35 , the multiplier 14 is halved and 35 is doubled. This changes the problem to 7×70 ; and you know at once that the answer is 490.

Change $18 \times 54\frac{1}{2}$ to 9×109 and you see, without any need to put pencil to paper, that the answer is 981. (Here is a rival method to the one described earlier for multiplying by 18.)

The whole "secret" of this method is that it converts a two-digit multiplier to a single digit; and it is easier to multiply by one digit than by two.

How to multiply mentally by 4, 8, and other powers of 2

When pencil and paper are not at hand, here is a way to multiply mentally by 4, 8, or 16: Double the number to be multiplied, as many times as the multiplier can be divided by 2.

Since 4 contains 2 twice, 4×73 can be calculated this way: "Twice 73 equals 146, and twice 146 equals 292."

If the multiplier is 8, instead of 4, you continue: "Twice 292 equals 584."

A problem like 16×65 can be done mentally by changing it successively to 8×130 , 4×260 , twice 520—and you have your answer, 1040.

Multiplying mentally by higher numbers

The term "Double-and-Halve" was chosen as descriptive, because the numbers of a problem may be changed most easily in this ratio. But this method is not limited to using the value 2.

If a multiplier is divisible by 3 or 4, multiplying and dividing by one of these values (instead of 2) will reduce a higher number to one digit, and often permit solving the problem mentally.

Using the value 3, for example, the problem 27×17 can be changed to 9×51 ; and the answer, 459, is evident.

To multiply by 140, 180, or 270, the only difference is that you would use the value 20 or 30, instead of 2 or 3. Thus (using 20), 140×35 becomes 7×700 , and the answer is 4900.

Paper-and-pencil short cuts by factoring a multiplier

Factoring a multiplier means splitting it into parts, called factors, of which it is the product. Multiplying a number by one factor, and the result by the remaining fac-

tor, gives the same answer as if the original multiplier were used.

You have already seen how simple it can be, for that is what we have just been doing; the "Double-and-Halve" Method actually amounts to a speedy mental way of factoring. Thus when we halved 14, in the problem 14×35 , we were really changing 14 into 2×7 . Doubling 35 was multiplying it by the 2. Then all that was left, to multiply by, was the 7.

Even when it is not mentally feasible to change both numbers at once, and get done with one of the factors at the outset in this sleight-of-hand fashion, factoring still is a useful short cut.

In paper-and-pencil factoring, you split a multiplier into a pair of factors, and multiply by each in turn. Which factor you use first does not affect the result, and can suit your convenience. For example, the most convenient factors of 32 are 8 and 4; of 56, 8 and 7; of 64, 8 and 8. To multiply 374 by 32, comparing this way with the conventional way:

Conventional

$$\begin{array}{r} 374 \\ \times 32 \\ \hline 748 \\ 1122 \\ \hline 11968 \end{array}$$

By Factoring

$$\begin{array}{r} 374 \\ \times 8 \\ \hline 2992 \\ \times 4 \\ \hline 11968 \end{array}$$

Note that multiplying by factors eliminates the operation of adding.

How to multiply mentally by $2\frac{1}{2}$, $3\frac{1}{2}$, $4\frac{1}{2}$, or $5\frac{1}{2}$

The mental "Double-and-Halve" Method can be applied in an alternate way: Instead of doubling the multiplicand (the number to be multiplied), and halving the multiplier, we can double the multiplier and halve the multiplicand.

To compute $2\frac{1}{2} \times 62$ mentally, all you need do is double $2\frac{1}{2}$ and halve 62. With practically no effort you see that 5 times 31 equals 155. The same procedure aids in multiplying by $3\frac{1}{2}$, $4\frac{1}{2}$, or $5\frac{1}{2}$.

(Again, the value used need not be limited to 2. Using 4 would conveniently change the problem $2\frac{1}{2} \times 440$ to 10×110 .)

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Another good use for this alternate version of the "Double-and-Halve" Method

is in multiplying by whole numbers that are simple fractions of 10 or 100.

Our short cuts for multiplying by 5, 25, and 50, given in the opening chapter, apply this technique. To multiply by 5 we change it to $10/2$; then, multiply by 10 and divide by 2. The order does not matter. If the multiplicand is an even number, you can just as well divide it by 2 first, and then multiply by 10; which exactly duplicates the "double-and-halving" procedure just described.

This completes the gamut of ways in which we can simplify a multiplier. It can be changed into a pair of numbers of which it is the *sum*, the *difference*, or the *product*; or, as we now see, the *quotient* (as 5 is, of 10 divided by 2).

TRY-IT-YOURSELF PROBLEMS

Mental:

A merchant plans an advertising campaign using 1,400 booklets at a cost of \$6 per 100. Using the "Double-and-Halve" Method, and taking no more than two seconds, compute the total cost of the booklets.

Ans. \$84

What will 8 chairs cost, at \$12.65 each?

Ans. \$101.20

Gun metal, a soft bronze, contains 16 parts of copper to 1 of tin. How many parts of copper would be used with 23 parts of tin to make this metal?

Ans. 368 parts of copper

A furrier receives a shipment of 17 pounds of skins, of which there are 18 to the pound. How many skins were received?

Ans. 306 skins

A ship can be loaded at the rate of 140 tons an hour. How many tons can be loaded in $32\frac{1}{2}$ hours?

Ans. 4,550 tons

A group of anglers catch 42 codfish which have an average weight of $4\frac{1}{2}$ pounds. Find in two seconds the weight of the entire catch.

Ans. 189 pounds

Written:

If drums of calcium chloride require 8.7 cubic feet of space apiece, how much space will be occupied by 32 drums?

Ans. 278.4 cubic feet

What would it cost to have 73 dozen belts sewn, at 56 cents per dozen?

Ans. \$40.88

A pump delivers $18\frac{1}{3}$ gallons of water per stroke. How many gallons will it deliver in 64 strokes?

Ans. 1,160 gallons

More Short Cuts in Multiplication

IF YOU had to multiply 34 by 6, would you write down 34 and 6 and then set down 4, carry 2, and so on? Consider this simpler way:

How to multiply mentally by a single figure

Think of 34 as 30 plus 4. Multiply these separately by 6 and add the products, doing this mentally, *from left to right*. Six times 30 equals 180; 6 times 4 equals 24; 180 plus 24 equals 204.

Three-figure numbers are multiplied as easily. You would compute 7×128 , mentally, thus: 7 times 100 equals 700, 7 times 20 equals 140, and 700 plus 140 equals 840; 7 times 8 equals 56; and 840 plus 56 equals 896. All you need actually say to yourself as you do this is: "700, plus 140 equals 840, plus 56 equals 896."

In mental multiplication it often is useful to think of the multiplicand in this way—not as a single number, but as so many hundreds, plus so many tens, plus so many ones. Actually, this "natural breakdown" of a number is just what its digits really mean.

Multiplying by 11 at sight

Even for as easy a task as multiplying by 11, there is a dazzling short cut, when the multiplicand has but two figures and their sum does not exceed 9:

Simply set down the multiplicand, leaving a little space between the two figures. Insert their sum in the space. Thus 43 multiplied by 11 equals 473; 70 multiplied by 11 equals 770. By picturing this procedure in your mind's eye, you can do it mentally in a flash. Half of the 90 two-figure numbers can be multiplied by 11 this way.

(The sum of the others' two figures ranges from 10 to 18, and what to do here is almost obvious: Put the last figure in the space, and add the 1 to the left-hand figure of the multiplicand. Thus the two figures of 57 add to 12; put the 2 between 5 and 7, add 1 to the 5, and you have 627 or 11×57 .)

To multiply a three-figure number by

11: Multiply its last two figures by 11 as just described; and add 11 times the hundreds digit, considered as hundreds. Thus 11 times 834 equals 374 plus 8800, or 9174.

How to square, or multiply by itself, any two-figure number

Square the tens digit and consider the result as hundreds. Add the square of the units digit. Then add 20 times the product of the tens digit times the units digit. To square 79:

$$\begin{array}{r} 7 \times 7 \times 100 = 4900 \\ 9 \times 9 = 81 \\ 7 \times 9 \times 20 = 1260 \\ \hline 79 \times 79 = 6241 \end{array}$$

How to square mentally a number ending in 5

Disregard the units digit 5. Multiply the rest of the number times 1 more than itself, and consider the result as hundreds. Then add 25, the square of 5. For example, to square 65 mentally:

$$\begin{array}{r} 6 \times 7 \times 100 = 4200 \\ 5 \times 5 = 25 \\ \hline 65 \times 65 = 4225 \end{array}$$

To square a number ending in 50 or 500, omit the final zeros, and proceed exactly as above. To the result, append twice as many zeros as the original number had. Thus, $650 \times 650 = 422500$.

Coins help to visualize numbers

Often it helps to solve problems about money, mentally, if you think of numbers in terms of actual coins: quarters, dimes, nickels, pennies.

You could compute, say, 80 times 28 cents this way: 80 quarters are \$20; 80 times 3 cents is \$2.40; total, \$22.40.

Whenever switching a tag like "cents" from one number to the other would help, you need not hesitate a moment to do it. How much is 25 times 34 cents? It is precisely the same as 34 times 25 cents: 34 quarters, or \$8.50.

Choosing a multiplier

In every multiplication problem, you can choose either number for the multiplier, and multiply the other by it.

Habitually, people multiply the bigger number by the smaller one. Since it is easier to multiply by one digit than two, and by two than three, this is *usually* the right way. But there are exceptions, even in conventional multiplication:

It is better to multiply 87 by 344 than 344 by 87. Note the repeated 4 in 344; you need multiply by 4 only once, using the result over again. So 344 has as few digits to multiply by as 87; and they are lower, easier digits.

Ones and zeros are effortless, really requiring no multiplication at all. So you would multiply 45 by 111, instead of 111 by 45; and 17 by 300 (actually multiplying 17 by 3, and adding two zeros to the result), rather than 300 by 17.

When our short cuts enter the situation, a number thus simplified naturally becomes the preferred multiplier, for reasons already made clear. And here, having the choice of using either number for the

multiplier takes on a special significance:

We have two opportunities to find a short cut for every problem in multiplication. If one of its numbers resists our methods, we can turn to the other and get a second chance, which greatly improves our prospect of success.

TRY-IT-YOURSELF PROBLEMS

Mental:

What will 6 shirts cost, at \$3.43 each?

Ans. \$20.58

A bundle of galvanized pipe weighs 123 pounds. How much will 7 bundles weigh?

Ans. 861 pounds

If a cow gives an average of 23 pounds of milk daily, how much milk will it give in 11 days?

Ans. 253 pounds

Compute the area of a room measuring 25 by 25 feet.

Ans. 625 square feet

Written:

Compute the area of a square whose sides measure 67 feet. **Ans. 4,489 square feet**

SHORT CUTS IN ADDITION

Addition is the simplest of everyday mathematical operations. Beyond some hints on adding mentally, the following chapter will be devoted to aids for avoiding errors in addition.

New Ways to Add Numbers

WHAT makes mental addition difficult for some is the "carrying" part. The need for carrying is eliminated if you add from left to right:

Mental addition without carrying

To add 234 to 3163 mentally, first add 200; then, 30; and, lastly, 4. These three simple steps successively give the partial totals 3363, and 3393; and the final total of 3397.

In adding 342 to 7847 mentally, this procedure gives the partial sums 8147 ($7847 + 300$), 8187 ($8147 + 40$), and the final total 8189.

To add numbers ending in 7, 8, or 9, mentally, it is sometimes convenient to increase the value of the last digit to 10; and, after adding, to subtract the value by which the original number was increased. To add 84 and 99, say: "84 plus

100 equals 184, minus 1 equals 183." To add 136 and 68, say: "136 plus 70 equals 206, minus 2 equals 204."

The last procedure will be found useful when the sum of the units digits is 10 or more, as in the examples given. It is needless if this sum is less than 10: In adding 358 to 241, there would be no point in changing 358 to 360.

Adding by the Two-Line Method

Many of us have been exasperated by the variety of answers obtained in adding long columns of figures, or a series of numbers running into six or more figures.

A paper-and-pencil method of addition which may be called the Two-Line Method makes it possible to go over a particular column once more, without having to start all over again.

Each column is added separately. The units figure of the total goes directly under the figures added. The tens figure, instead of being carried, goes on a separate line below, one space to the left. When every column has thus been totaled, adding the two lines of figures gives the answer.

Here is the way this procedure looks, after adding the first column; after adding all the columns; and after adding the two-line subtotals:

\$6235.18	\$6235.18	\$6235.18
473.56	473.56	473.56
1920.71	1920.71	1920.71
4364.16	4364.16	4364.16
1	1882 41	1882 41
2	11111 2	11111 2
		\$12993.61

If any column added up to less than 10, you would put a zero at the corresponding place in the second line.

Adding by the "Angular" Method

In this method, the sum of each column has a line to itself; and the subtotals form an "angle" with the answer.

The columns may be added either in conventional right-to-left order, or from left to right. Here is an example of the same problem, done both ways:

428	428
743	743
285	285
176	176
22	14
21	21
14	22
1632	1632

By dispensing with carrying during the

adding of the columns, both the Angular Method and the Two-Line Method eliminate time-wasting errors occurring that way. So in the long run these aids, too, may prove to be short cuts over conventional procedure.

TRY-IT-YOURSELF PROBLEMS

Mental:

Add the following pairs of numbers:

572 and 216.	Ans. 788
613 and 324.	Ans. 937
735 and 152.	Ans. 887
944 and 361.	Ans. 1,305
245 and 57.	Ans. 302
\$14.75 and \$3.42.	Ans. \$18.17
\$12.66 and \$5.48.	Ans. \$18.14

Written:

Add by the Two-Line Method:

\$2,612.15, \$923.81, \$1,617.57,	
\$2,328.18.	Ans. \$7,481.71
\$7,109.23, \$218.14, \$3,106.27,	
\$1,934.85, \$2,075.63.	Ans. \$14,444.12

Add by the Angular Method, and check your answers by the Two-Line Method:

\$1.89, \$3.42, \$5.86, \$8.27.	Ans. \$19.44
\$52.60, \$84.73, \$91.26, \$15.92.	Ans. \$244.51
\$102.46, \$273.91, \$91.82, \$146.73,	
\$51.20.	Ans. \$666.12

SHORT CUTS IN SUBTRACTION

Subtraction, like addition, is a comparatively simple operation. Therefore the only unconventional method of subtraction offered here will be a mental one.

How to Subtract Mentally

SUPPOSE you made a \$2.95 purchase and paid with a ten-dollar bill. You doubtless would have no difficulty in calculating mentally just how much change to expect; you would subtract \$3 from \$10, and add 5 cents to the difference. It is really very simple.

Yet many find it difficult to subtract 43 cents from 97 cents mentally.

Subtracting two-figure numbers. A very practical procedure is to increase the number to be subtracted, mentally, to the nearest multiple of 10; and to increase the other number by the same amount. This changes the foregoing problem—97 cents minus 43 cents—to \$1.04 minus 50 cents. You know instantly that the answer is 54 cents.

Subtracting three-figure numbers. In subtracting 348 from 624 it is more practical to increase the number to be sub-

tracted, 348, to the nearest 100. Thus it becomes 400; and 624 (likewise increased by 52) becomes 676. You see at a glance that 400 from 676 leaves 276.

Subtracting four-figure numbers. Solving the problem 6420 minus 5865 may take just a little more effort. Here you increase the number to be subtracted, 5865, to 6000. Since you have added 135 to 5865, you must also add 135 to 6420. The problem has thus been changed to 6555 minus 6000. And without further thought you know that the answer is 555.

The principle of this method, of course, is based on the fact that it is easier to add than to subtract.

TRY-IT-YOURSELF PROBLEMS

Mental:

The horsepower range of a heavy-duty diesel engine is from $16\frac{1}{2}$ to 55. By how much does the latter exceed the former?

Ans. $38\frac{1}{2}$ horsepower

A cubic foot of Portland cement weighs 183 pounds. A cubic foot of concrete weighs 144 pounds. What is the difference in weight per cubic foot?

Ans. 39 pounds

How much more water does a 365,000-gallon tank hold, than a 328,000-gallon tank?

Ans. 37,000 gallons

A home was bought for \$29,750, and sold for \$33,500. How much profit was made on the sale?

Ans. \$3,750

SHORT CUTS IN DIVISION

Division can often be as simple as multiplication. Many difficult-looking problems can be solved with fascinating ease and speed—quite often, without recourse to pencil and paper.

The "Double-and-Double" Method

JUST as it saved effort to change a multiplier into simpler form, so division can be made easier by simplifying a divisor (the number by which the other, called the dividend, is to be divided).

While we cannot break down a divisor into the sum or difference of two numbers (as we did a multiplier, by the Breakdown Method), we can apply counterparts of the short-cut techniques of our "Double-and-Halve" Method of multiplying.

In division, the result will be unchanged if we double *both* the divisor and the dividend; or if we multiply or divide them both by the same number, whatever it may be. This is the principle of the "Double-and-Double" Method now to be considered.

How to divide quickly by 5, 15, and 35

To divide by any of these numbers, double both the dividend and divisor and proceed, as illustrated in the examples given below:

5. To divide 175 by 5:

$$350 \text{ (twice 175)} \div 10 \text{ (twice 5)} = 35$$

15. To divide 135 by 15:

$$270 \text{ (twice 135)} \div 30 \text{ (twice 15)} = 27 \div 3 = 9$$

35. To divide 420 by 35:

$$840 \text{ (twice 420)} \div 70 \text{ (twice 35)} = 84 \div 7 = 12$$

In these examples, to show the procedure most simply, the dividend was exactly divisible by the divisor. If it is not, the technique works just as well. To divide 138 by 15, you would likewise double the dividend and divisor, and have: $276 \div 30 = 27.6 \div 3 = 9.2$.

Here we have applied the "magic of the tens" to make dividing easier, by converting 5 into 10, and 15 and 35 into multiples of 10. The two-digit divisor 15 or 35 becomes a single-digit divisor, 30 or 70; and it is easier to divide by one digit than two.

Dividing by 25, 75, and other numbers ending in 5 and 50

The same principle is applied, sometimes with appropriate variations, to divide by other numbers ending in 5:

25. Doubling 25 gives a one-digit number, 50; but by doubling it again we get a still easier divisor, 100. So, to divide by 25, you would multiply dividend and divisor by 4 and proceed.

75. Twice 75 is 150; but doubling it once more gives a one-digit divisor, 300. So here, again, you multiply dividend and divisor by 4. Thus the problem $1200 \div 75$ becomes one you can work mentally: $4800 \div 300$, or $48 \div 3$, which equals 16.

Three-digit numbers ending in 5. Many of these, when doubled, become two-digit numbers: Twice 135 is 270, twice 165 is 330. And it is obviously easier to divide by 270 or 330 than by 135 or 165.

If a number ends in 50 instead of 5, it does not make a bit of difference. The divisor 350 can be as conveniently changed to 700, as 35 to 70.

TRY-IT-YOURSELF PROBLEMS

Mental:

Mince meat is put up in 5-pound wood pails. How many pails will 3,400 pounds of mince meat fill? **Ans. 680 pails**

How many 5-ounce packages can be filled from 2,000 pounds of dehydrated eggs? **Ans. 6,400 packages**

A trailer body for frozen products requires 2500 pounds of dry ice for each day in transit. For how many days will 4,250 pounds of dry ice suffice? **Ans. 17 days**

How long would it take to dust 8,400 acres by airplane, at the rate of 350 acres per hour? **Ans. 24 hours**

Written:

If it takes 15 squares of shingles to roof a house, how many houses can be roofed with 435 squares of shingles? **Ans. 29 houses**

How many cases, each of 35-pound net weight, can be filled from 2,695 pounds of frozen eggs? **Ans. 77 cases**

How many bars of electrolytic copper, weighing 135 pounds apiece, would total 2,835 pounds in weight? **Ans. 21 bars**

It costs a manufacturer \$416.25 to assemble 185 units. How much is that per unit? **Ans. \$2.25**

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The "Double-and-Double" Method of dividing, like the "Double-and-Halve" Method of multiplying, has alternate versions.

As applied in the chapter just con-

cluded, the procedure has the effect of transforming a divisor into a pair of numbers of which it is the quotient; for example, 5 into $10 \div 2$.

In the following chapter, a variation of the method amounts to changing a divisor into a pair of numbers, or factors, of which it is the product.

"Halve-and-Halve" Division

THIS alternate version of the "Double-and-Double" Method uses the principle that it is often helpful to *divide*, instead of multiply, a dividend and divisor by 2 (or 4, or some other number).

Dividing by 14 and other low, two-figure even numbers

The labor of dividing any even number by another can be reduced by first halving both the dividend and divisor. The ease of dividing any number by 2 mentally makes this a valuable technique. It is especially advantageous with divisors like 14, 16, and 18, which become a single digit when halved.

To divide 56 by 14, you need but restate the problem as $28 \div 7$ to see instantly that the answer is 4. You can divide 128 by 16 mentally and effortlessly by changing the problem to $64 \div 8$.

Similarly, to divide 3114 by 18: $1557 (\frac{1}{2} \text{ of } 3114) \div 9 (\frac{1}{2} \text{ of } 18) = 173$.

To divide by 20 it is necessary only to halve $1/10$ of the dividend. Thus $2460 \div 20 = 246 \div 2 = 123$; and $187 \div 20 = 18.7 \div 2 = 9.35$.

How to divide mentally by 4, 8, and other powers of 2

Earlier we saw how to multiply mentally by a power of 2. Now we reverse the procedure:

To divide 72 by 4 mentally, you say to yourself: "72 divided by 4, equals 36 divided by 2, equals 18."

If you were to divide 288 by 64, you would start off, "288 divided by 64, equals 144 divided by 32," and so on. You can divide mentally by powers of 2 at least as high as 128 in this way.

How to divide quickly by various factorable numbers

In effect we have just been factoring a divisor into 2 and another number, and dividing by each factor in turn. We are not restricted to factors including 2.

The divisor 24 (like the multiplier 24) can be factored into 3 and 8, or 4 and 6, as well as 2 and 12. To divide 4488 by 24, using the factors 4 and 6:

$$4488 \div 24 = 1122 \div 6 = 187$$

Other numbers, such as 32, 52, 56, and 64, likewise may be factored as divisors just as they would be as multipliers. Example: Compute the weekly salary (to the nearest cent) of an employee earning \$200 a month. Solution: \$200 per month equals \$2400 per year, or per 52 weeks; $\$2400 \div 52 = \$600 \div 13 = \$46.15$. (Here, 52 was factored into 4×13 , and \$2400 was divided successively by 4 and 13.)

How to divide when problems involve large numbers

We have seen how easy it is to divide by factorable two-figure numbers, especially if the dividend is also divisible by one of the factors; while not essential, this is an added advantage.

Now let us see how the principle can be applied to larger numbers.

First we need ways to tell, for example, whether 38908 is divisible by 4, or whether 78435 is divisible by 9. The following hints offer just such a guide:

A number is divisible by:

- 3, if the sum of its digits is divisible by 3.
- 4, if its last two figures are zeros, or form a number divisible by 4 (like 24).
- 5, if its last figure is zero or 5.
- 6, if it is an even number, and the sum of its digits is divisible by 3.
- 8, if its last three figures form a number divisible by 8 (like 144).
- 9, if the sum of its digits is divisible by 9.
- 11, if the difference between the sum of the figures in the even places, and the sum of the figures in the odd places, is zero or 11.

Now to try it. To divide 38908 by 284:

We see at once that 284 is divisible by 4. Is 38908, also? Since it ends in 08, which is divisible by 4, we know that it is.

So we can simplify our problem to: $9727 (\frac{1}{4} \text{ of } 38908) \div 71 (\frac{1}{4} \text{ of } 284)$. See how effortless it is to complete this, compared to dividing 38908 by 284:

Original problem Simplified problem

$\begin{array}{r} 137 \\ 284 \overline{) 38908} \\ \underline{284} \\ 1050 \\ \underline{852} \\ 1988 \\ \underline{1988} \\ 0 \end{array}$	$\begin{array}{r} 137 \\ 71 \overline{) 9727} \\ \underline{71} \\ 262 \\ \underline{213} \\ 497 \\ \underline{497} \\ 0 \end{array}$
--	--

If our problem were to divide 82604 by 428, dividing both by 4 would simplify it to $20651 \div 107$. What better figures can you wish for, in a divisor, than 1 or 0? And, with judicious factoring, such things can often be brought about by design. Here is a case in point:

Consider the problem $78435 \div 945$. Since each number ends in 5, we know that both are divisible by 5, and we could shorten the computation by dividing them by that number. However:

A quick glance also tells us that 945 is divisible by 9, which would give us the very desirable divisor 105. To see whether 78435 is divisible by 9, too, all we need do is to see whether the sum of its digits is divisible by 9. We find that it is. So our problem is simplified to: $8715 (\frac{1}{9} \text{ of } 78435) \div 105 (\frac{1}{9} \text{ of } 945)$. And here is all that is left to do:

$$\begin{array}{r} 83 \\ 105 \overline{) 8715} \\ \underline{840} \\ 315 \\ \underline{315} \\ 0 \end{array}$$

TRY-IT-YOURSELF PROBLEMS

Mental:

(Write down no more than the answers)

How many gallons of vinegar will fill 372 quart bottles? **Ans. 93 gallons**

A research engineer put in 32 hours on an assignment for which he received a fee of \$280. How much did that average per hour? **Ans. \$8.75**

Compute the number of bushels in 1,344 dry pints. (One bushel equals 64 dry pints.) **Ans. 21 bushels**

How many cords of wood are contained in 1,408 cubic feet? (One cord of wood equals 128 cubic feet.) **Ans. 11 cords**

Written:

A roll of fabric weighs 14 pounds. How many such rolls does a shipment of 252 pounds contain? **Ans. 18 rolls**

An oil refinery is reported to be producing 170,000 barrels, or 24,000 tons, of oil per day. By these figures, how many barrels of oil equal a ton? (Hint: Factor 24 into 2 and 12.) **Ans. 7-1/12 barrels**

If 32 gallons of sugar-maple sap will make one gallon of syrup, how much syrup can be obtained from 544 gallons of sap? **Ans. 17 gallons**

What amount (to the nearest cent) is earned weekly by an employee whose yearly salary is \$3,420? **Ans. \$65.77**

A contractor needs 1,000 square feet of insulation tile, which is obtainable only in full cartons of 64 square feet each. How many cartons should he order? **Ans. 16 cartons**

How long, to the nearest minute, would it take to handle 45,000 yards of material on a warping machine at a speed of 918 yards a minute? (Hint: Note that 918 and 45,000 are both divisible by 9.) **Ans. 49 minutes**

CHOOSING AND USING SHORT CUTS

Now, in conclusion, an overall look at the short cuts that have been presented here:

WE HAVE seen the almost endless ways in which the numbers of a problem can be manipulated. Viewed for the first time, it may seem a bewildering variety; and you may wonder how you are to tell, in any given case, which short cut to try.

Actually this is simple enough. Even in a brief glance at a problem, it is perfectly possible to determine systematically whether you can use a short cut and what kind to use.

How to do it may be seen from the principles already presented:

Planning to multiply. Given a problem in multiplication, for example: Either number, you remember, can be used as the multiplier. Mentally you try raising or lowering each one to a nearby round number. Can either be changed, by adding or subtracting a very small or easy-to-use number, into a neighboring multiple of 10? Or of 25, or 100? If so, the Breakdown Method may be promising.

Or, looking again at the numbers, can either be factored into simpler ones—a possibility that may already have made itself obvious? If so, the “Double-and-Halve” Method can come into play.

Planning to divide. Given a problem in division with numbers of moderate size, it should be possible to tell, mentally and

quickly: Will the problem be simplified if the dividend and divisor are halved? Or doubled? Or multiplied or divided by some other number than 2? If so, this will be the time to apply one of the versions of the “Double-and-Double” Method.

In much less time than it takes to tell it, a suitable short cut can thus be chosen. With only a little practice, using the examples in this book as a guide, you will soon find yourself recognizing intuitively the most appropriate way to deal with any problem.

New power over numbers. Whenever they can be applied, the short cuts described here are unreservedly recommended, in preference to any other method. Moreover, they can serve as a quick, independent, and therefore excellent way of checking computations already made by conventional methods.

While it is not to be imagined that these short cuts will replace conventional computation entirely, the range of problems to which they are applicable has been seen to be wide indeed.

For these are not trick methods adapted to the exception; rather, they are suited to the rule. An unhurried study of them will enable you to enjoy a new-found power over numbers, and will help you to find the answers to thousands of different problems.

Mechanics and Handicraft SECTION



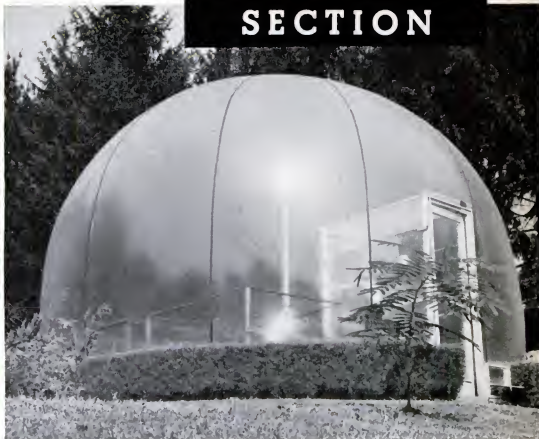
AS A SUN ROOM: Enjoy winter-long sun baths in this solar-heated, backyard air house. Although the ultraviolet-filtering action of the plastic prevents tanning, by the same token it keeps you from getting a sunburn.



AS A POOL COVER: Set up a portable pool inside the plastic dome and you can bathe all winter. Or use the same type of dome to enclose a permanent swimming pool.



AS A PHOTO STUDIO: Soft, diffused light needs only a half stop larger camera opening than outdoor sunlight for beautiful portraits without hot spots, harsh shadows, or dark areas. A revolving stage in the dome helps you light your subjects from any angle.



Air-Bubble Sun Port for \$50

By Sheldon M. Gallager

HOW would you like to take a sun bath in your back yard with the snow piled high around you? Or have picnics in an outdoor family playroom that you can use all winter? Or go swimming when the temperature is down to freezing? Or grow colorful flowers the year 'round in your own greenhouse?

You can do all these things—and more—in a plastic air bubble that can be put up in your back yard for as little as \$50. The air bubble—newest, cheapest, most exciting way to add fun space to your home—is simply a dome made of thin plastic blown up like a balloon. A shimmering, silvery hemisphere, it looks like a giant plastic food bag and should—it's made of essentially the

AS A GAME ROOM: Add a Ping-pong table, pool table, shuffleboard, croquet, or other games and you can play while the snow flies. Larger domes can cover a tennis or badminton court.

CONTINUED

same filmy plastic material as the bags.

The dome is supported entirely by air and needs no frame. It gets its remarkable warmth by trapping solar heat the same way a greenhouse does. Temperatures inside rise to as high as 80 or 90 degrees even when it's freezing outside.

In the dead of winter, you can sun yourself in a bathing suit, play outdoor games, or go for a swim after you've shoveled out the driveway. The plastic dome is so completely portable that you can set it up in the fall, store it away in the spring, shift it from one location to another, and take it with you if you move.

The air house you see on this and the preceding page was built by Ernest Muehlmann of Media, Pa. It's 13 feet tall and about 18 feet in diameter, providing a floor area of 250 square feet. That's equivalent to adding a 14'-by-18' living room to your home.

Muehlmann, a professional florist, originally built the air bubble as a greenhouse, but now finds it overrun on chilly days by neighborhood kids who like to play in its sunny warmth. With no supplementary heat, the inside temperature, he says, is always 40 to 50 degrees above the outside temperature, even on the coldest sunny days. By adding a small electric or oil heater, you can keep the dome warm at night or on cloudy days. Use the dome to cover a swimming pool and you can swim nine months out of the year with no extra heat, or all winter if you add a pool heater.

Cost of the Muehlmann air house: about \$30 for 1,000 square feet of plastic, \$2 for a junked furnace blower that supplies the air, and a few odds and ends that bring the total to less than \$50.

New uses for air houses. Originally designed as enclosures for radar installations, air-supported structures are now becoming popular for giant warehouses, for construction-work shelters so that building can continue in any weather, for mobile shops, garages, boat-storage ports, schools, hospitals, and churches—you name it, they've done it.

The most ingenious new use for the air bubble is an outdoor winter playroom. In the size built by Muehlmann, there's ample space for a Ping-pong table, picnic table, lounge chairs, and kids' play equipment. With a larger



DOMES CAN'T COLLAPSE if power fails, because a center pole holds it up like a tent. Photo above was taken five minutes after blower was shut off; the dome is still two-thirds inflated.



UNDERSIDE OF DOME shows how pie-slice segments of plastic meet at the peak. Center pole, made of 1½" pipe, is 2' shorter than top of dome, serves as a handy stand for lights as well as an emergency support for the dome. Metal reflector (an old charcoal grill) fastened to top of pole keeps the pipe from tearing the plastic if the dome should collapse.

enclosure, you could cover a tennis or badminton court.

Air houses are virtually stormproof, too, because they are flexible and give under impact. In last fall's Hurricane

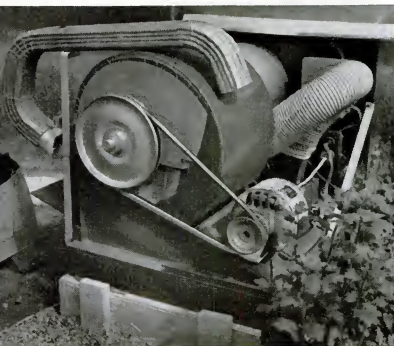
a junked furnace blower built this remarkable air house



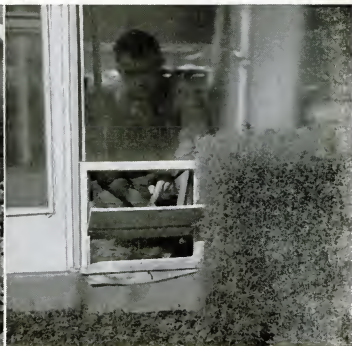
IT'S A TROPICAL PARADISE in your own back yard. Ernest Muehlmann originally built this solar-heated huddle to serve as a greenhouse, but now finds many other surprising uses for it.



DOUBLE-DOOR AIR LOCK keeps air from escaping from the dome as you enter and leave. It's merely two door frames held 5' apart by furring strips with plastic film stapled over it.



OLD FURNACE BLOWER, bought for \$2, is driven by a 1/3-hp. washing-machine motor to inflate the dome. A 4" pulley on the motor and a 10" pulley on the blower turn the blower at about 700 r.p.m. The piece of downspout on top picks up air from the blower and directs it at the motor to cool it. A tiny 4" blower, used at night, is hidden behind the main blower.



ADJUSTABLE DAMPER, 15" square, automatically keeps pressure constant inside the dome. It's counterweighted so that falling pressure lets it close, while rising pressure pushes it open. It can also be manually tilted to increase or decrease ventilation. Total vent area for an 18'-diameter dome like this should be at least 200 sq. in., not more than 300.

Donna, Muehlmann's dome merely shimmied a bit while shrugging off the lashing winds. Snow and sleet slide off the curving sides without piling up.

You can buy ready-made air houses

in sizes up to 150 feet long, but they're expensive. Prices range from \$1 to \$3 a square foot of ground area covered, meaning that a ready-made enclosure the size of Muehlmann's could run as

CONTINUED

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AIR HOUSE OVER A POOL in Seattle, Wash., was the scene of this lively event—a winter swim-

ming party. The oval-shaped air structure is a product of the Seattle Tent & Awning Co.

high as \$750. By making your own, you can cut the cost to a fraction of this.

Since ultraviolet light causes plastic films to deteriorate, the films are made to filter out these rays. This has an unfortunate result—you won't be able to acquire a suntan in an air house. However, newer films, not yet on the market, may eventually permit tanning.

How an air house works. The extremely light weight of the plastic—less than one ten-thousandth of a pound per square inch—is the secret of the air bubble. It requires only a fraction of an ounce of air pressure to keep the bubble inflated against normal atmospheric pressure outside. In fact, the difference in pressure inside and out is so slight that it's less than the difference you feel during daily weather changes or in going from the top to the bottom of a tall building.

Almost any small blower—even a hair dryer or vacuum cleaner—will inflate the dome. It's best, however, to use a blower that's designed for continuous duty. The blower must also have enough excess capacity so that some of the air can be continually leaked out for ventilation.

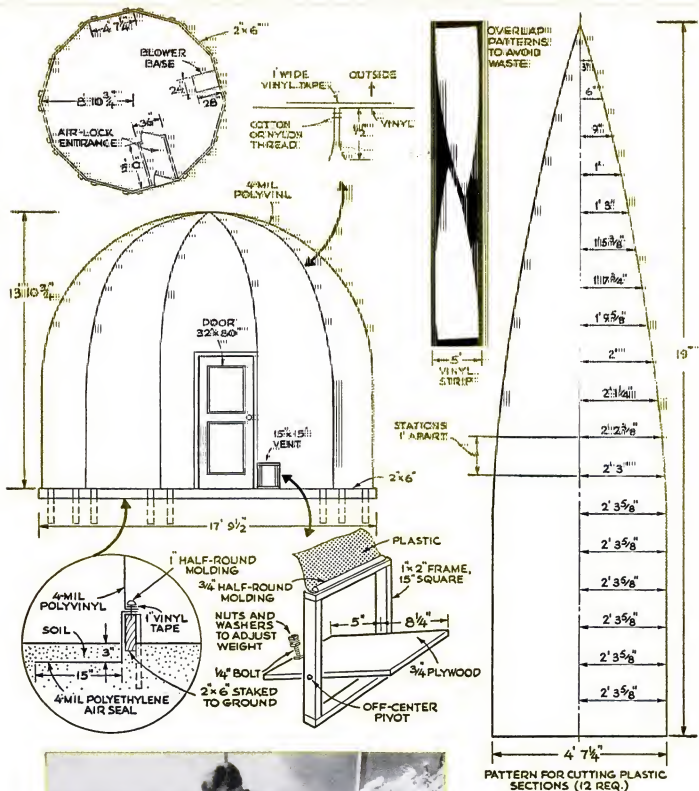
Muehlmatt uses a 12" blower from a

warm-air heating system during the day because a large volume of air is needed—not to hold the dome up, but to keep it from getting too hot inside. At night, he switches over to a tiny 4" fan scrounged from an automobile heater. This supplies plenty of air to support the dome but with less ventilation, which also helps to keep the dome warmer. On very cold nights, he fires up a small oil heater to take the chill off.

Both the 12" and 4" blowers have been running constantly, a half-day each, since last spring with no trouble. The intake ports are mounted in a common frame that's set into the side of the dome with the plastic stapled around the edges. For added warmth, you can buy a combination blower that includes an electric heating element to warm the air before it enters the dome. The blower can also be run without the heater when you don't need it.

Controlling the airflow. A self-balancing vent in the side of the dome automatically controls the flow of air. A counterweighted damper closes as the pressure falls and opens as it rises, keeping the dome at a constant pressure.

[Continued on page 218]



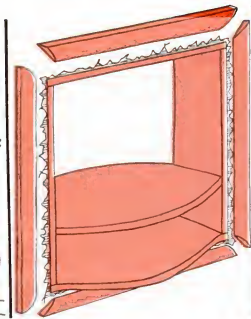
30° OUTSIDE—80° INSIDE: This air-bubble "hothouse" makes a cozy winter playground for kids—or grownups.

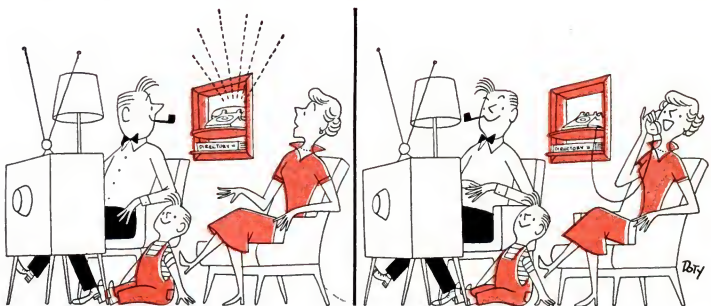
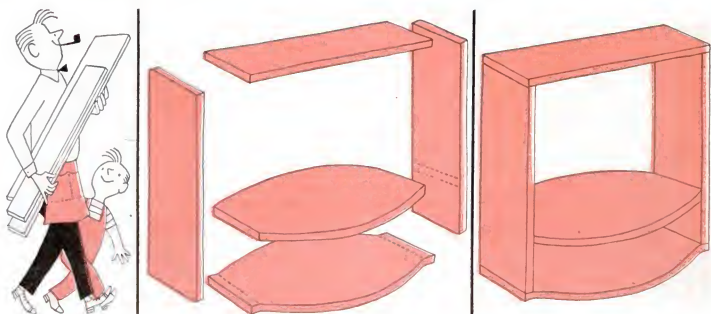
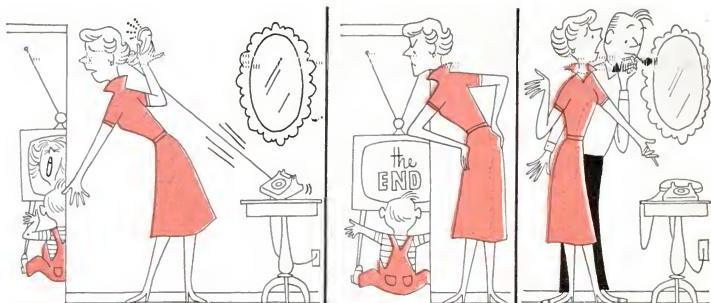
Blueprints Available

WANT working drawings of the air house shown on these pages? A scaled blueprint showing how the plastic sections are laid out and cut, and detailed instructions for building the enclosure, are available for \$1 from Ernest Muehlmann, Route 27, Media, Pa.

Wordless Workshop

By Roy Doty
and Alfred W. Lees



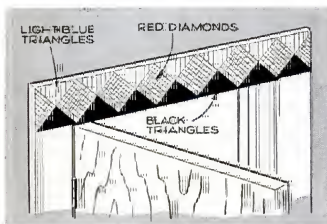


Short Cuts and Tips

FROM RS READERS

Silent Warning: It Can Happen Here

AS PART of our safety program, two shop employees at this Recreation Area marked the table of the radial-arm saw with a grisly, but effective reminder that power tools can be dangerous. Each man had lost a finger as the result of an accident on a previous job. Spray-painted outlines of their hands are labeled with their nicknames and captioned with the warning: "THINK." Other users of the saw treat it with proper respect.—Homer W. Robinson, *Coulter Dam, Wash.*

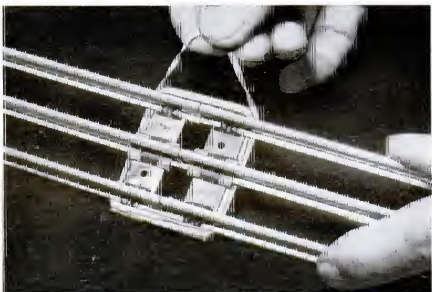


Safety Design for Low Door

MY WORKSHOP has so low an entrance that most folks can't get through without ducking their heads. When I tried to alert them to this danger by painting the top of the casing bright red, I found out that people only saw red after they'd whacked into it! By adding black and blue (in the design shown), I made my point—and I've had no more bumped heads to doctor.—Herman G. Allen Jr., *Morrisville, N. Y.*

Join Toy Track with Rubber Bands

TO KEEP the tracks for that Christmas train from pulling apart, slip rubber bands around the end ties of adjoining sections. Switches and crossovers, which have no ties, can be secured by stretching rubber bands under them from the track sections at each end. Tie several bands together, if necessary, to get sufficient length.—William Swallow, *Brooklyn, N. Y.*





Fixing I. F. Amplifier Faults

When the TV signal leaves the tuner it has been converted to a fixed intermediate frequency (I.F.), regardless of the channel selected by the tuner. The I.F. amplifier, consisting of two to four stages, has the major responsibility for boosting the feeble incoming signal to a voltage strong enough to control the light on the screen.

There can be from two to four I.F. tubes in your set. Most often there are three. Usually they are all of the same tube type and are arranged in single file, leading away from tuner. They are covered by metal shields that must always be replaced.

By Art Margolis

YOU amateurs are ruining the profession. You buy an expensive camera and as soon as you can make a recognizable picture, you think you're a photographer." Joe Petersen was fuming about his favorite topic. Joe owns the photography studio next door and he's been processing the pictures I take to illustrate these articles. Ever since he found out they were for publication, he has been complaining about my "infringing" on his profession.

CONTINUED



NEGATIVE PICTURE can be caused by defective I.F. tube, often the last one in the I.F. strip. Improper setting of contrast or A.G.C. control, or too strong a signal, are other possibilities.



TUNABLE GHOSTS, secondary image outlines that come and go with fine-tuning adjustment, are caused inside the TV. Check shields on I.F. tubes. Try replacing I.F. tubes one at a time.

As he tossed my latest batch of negatives onto the desk, I saw he was carrying a 17" portable TV. He hefted it onto the service counter, ducked under the "No Admittance" sign, plugged in the TV, and attached the antenna leads.

As I looked up from examining my negs, his TV picture started to get very contrasty and began to weave. Then it turned inside out—the blacks turned white and the whites black, like a negative.

Joe scratched his head and muttered to himself, "If that was a photo print, I'd say the white light had been flashed on when the print was half developed. I wonder what causes a TV to reverse."

I answered to the back of his head, "Check the I.F. amplifier tubes."

Without a sign that he had heard me, Joe took the back off the set, checked the tube-location guide pasted inside and plucked out the I.F. tubes—just as if he'd known all along what to do.

As the signal passes through the I.F. strip, each tube puts out a much stronger signal than it received from the preceding tube. If a tiny fraction of this amplified output finds its way back into the input, it is amplified again.

One way some of the output can creep back into the input is through stray capacitance between input and output elements of the tube. If, by aging, this capacitance increases, the feedback may become great enough for the tube to oscillate. If there is strong enough oscillation, it will upset the processing of

the signal and even turn the picture inside out, as in Joe's case.

Joe walked over to my tube rack and helped himself to two 3CB6s. With these two new tubes in the set, a sharp, clear picture came on, and it stayed that way. Joe put his TV back together and walked around to the other side of the counter.

"Here Rembrandt, take out for two 3CB6s," he said, tossing down a bill.

"That was a pretty quick job of trouble-shooting, Joe," I said. Handing him his change, I added, "—for an amateur."

The Mystery of I.F.-Strip Ghosts

MY NEPHEW Pete, who fixed his first radio at the age of 10, helps me out at the shop occasionally. But now, at 17, the sparkle in a maiden's eye is more likely to capture his attention than electrons.

Last week he phoned me an S.O.S. from his girl's house where he had just replaced the picture tube in her TV.

"Art, could you drop in at Joan's, and make it casual—like it was an accident?" Pete was whispering so softly I could scarcely hear him.

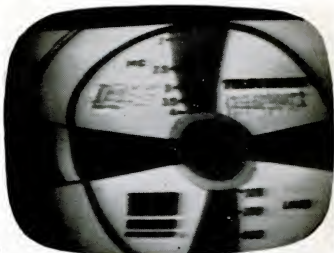
He was on the roof fiddling with the antenna when I arrived. He scrambled down, and talked me to the door.

"Picture-tube replacement was a cinch. Noticed picture static when I moved the I.F. tubes around in the sockets. Pulled 'em and sprayed solvent in the pin holes to clear out the corrosion. Brightness

of your set can cause any of these troubles



WASHED-OUT PICTURE that can't be corrected by adjusting the contrast or A.G.C. controls may be due to one or more weak I.F. tubes. Try new tubes one at a time. And replace shields.



TOO MUCH CONTRAST and pulling indicates overload. If it still occurs when one side of antenna lead is disconnected, trouble is inside the set. Replace I.F. tubes one at a time.

and contrast are fine, but there's a bad ghost. Turning the antenna doesn't faze it. I'm stumped, Art, but I can't let Joan know it."

A cute little redhead was sprawled on the floor in front of the TV.

"Joan, this is my Uncle Art. He was passing by, saw me on the roof, and stopped," Pete explained.

The smile and unexpectedly throaty "Hi" almost made me 17 again.

I strolled casually over to the TV and twisted the fine-tuning knob. The ghost moved in and out. "I see you've got a little ghost problem," I said to Pete.

"Yeah," he said airily, "but I'll take care of that with a few adjustments."

When a ghost is not tunable, it's coming in on the antenna. If it can be tuned with the fine-tuning control, the spook is inside the set. Chances are great that the defect is in the I.F. strip. It's heavily shielded to prevent any external interference. Metal caps cover the tubes and there is a metal enclosure around the circuitry. If any of these shields are left out, there can be all kinds of peculiar interactions among the various circuits.

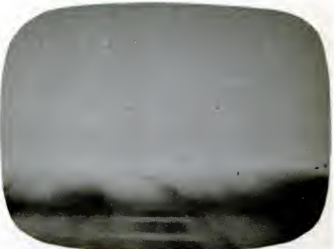
I had spotted something when I walked in that tipped me off. Pete would have known what to look for, too, if he could have got his mind off those big blue eyes.

I started to leave and panic turned Pete's face into a mask of consternation. I motioned toward the corner of the room where Joan's little brother was playing

[\[Continued on page 224\]](#)



SNOWY PICTURE, with white flecks appearing all over the screen, may be due to weak I.F. tubes. Note if the snow has a regular-beat pattern. This is the tip-off to I.F.-caused snow.



DARK BAND across the picture is caused by 60-cycle hum. A heater-to-cathode leak or short in any tube in the signal path will cause it. Replace tubes till you find the bad one.

Shaping the Savannah Superstructure

Part II: Now add the fine details to your four-foot model of the nuclear-powered merchant ship

By Henry B. Comstock

LAST month you made a single part for your Savannah model—a gleaming-white fiber-glass hull over four feet long.

This month you'll assemble an exciting variety of small parts. Thank the big Savannah for that. Because she's designed to carry a limited number of VIP passengers in addition to cargo, she sports such plush features as a swimming pool and an impressive row of promenade-deck windows on either flank.

Eyelets for portholes. For a breather, dress up the hull before you start the

superstructure. At a dime or hardware store, pick up an eyelet kit. Count out 68 eyelets, lay them on wax paper, and spray them white with aerosol enamel.

Next, use your Savannah plans to spot 34 portholes on both sides of the hull. Drill $\frac{3}{16}$ " holes through the fiber-glass, and cement an eyelet into each.

Tailoring hull to main deck. The design of your pattern and mold has produced a hull with a clean top edge, or "sheer line." The fiber-glass folds inward there, forming a $\frac{1}{4}$ " lip all around the ship. For good looks and a trim deck fit, fill the recess beneath the lip.

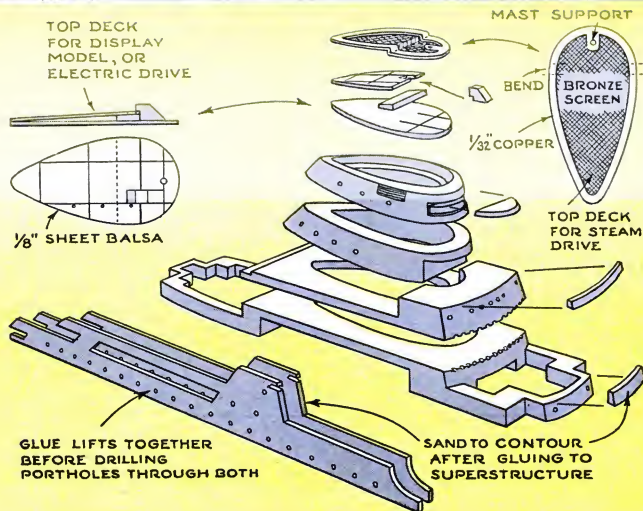
To do it, cement strips of sheet balsa to the inside of the hull just below the lip. Make them wide enough to extend below the underside of the deck. Sand the balsa flush with the inner edge of the lip. Then apply three coats of sanding

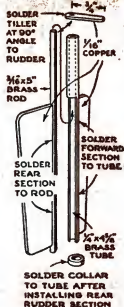
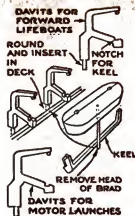
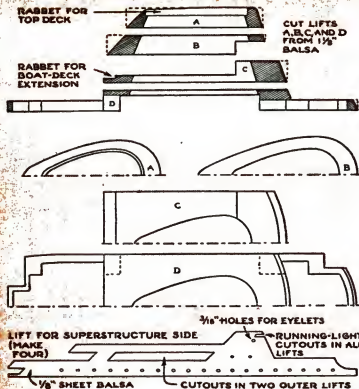
CONTINUED

PILOT MODEL of the Savannah was assembled with screws and dowels so that assemblies could be parted to show construction. An unforeseen dividend was the discovery that a removable

reactor deck, made for quick steam-gauge readings, and a similarly free sports deck make a convenient handhold for lifting the superstructure from the hull for fueling the boiler.







BALSA-WOOD SUPERSTRUCTURE is practically a must for stability in the water. Apart from a few tiny metal parts, plastic masts, and hardboard lifeboat davits, everything abovedeck is made of this featherweight material. Copper and brass are used for the propeller and rudder.

sealer. After each dries, smooth with fine sandpaper. Finally, apply two coats of flat-white enamel.

Fitting the main deck. The patterns

for this three-part assembly are shown in last month's plans. Cut the two deck sections and the spacer that separates them from a 6"-wide strip of 1/8"

A Second Way to Mold the

ONCE you have made the mold described last month, you can laminate a sturdy hull for the Savannah by bonding layers of newspaper with water glass or glue. Twelve or more layers make a hull about 1/16" thick.

Water glass is best because it remains slippery throughout the laminating process. This permits you to slide each layer into position and saturate it without pulling it out of place with the brush. It is a syrupy liquid, sold in hardware stores for preserving eggs and fireproofing flammable materials.

Coat the mold with cold cream, then start laying in paper and brushing it over with water glass. Lay the larger pieces amidships, and fit smaller strips into the bow and stern. If you can't finish the hull in one day, it's safe to stop and resume the next day.

After removing the hull, clean off the cold cream with benzine, and apply a coat of shellac or paint, inside and out, to

SATURATE THE FIRST STRIPS by brushing them with water glass, and lay them in the mold. Succeeding strips can be placed in the mold dry, then set by brushing in more water glass.



balsa. Cement them together and apply the reinforcing strips that give the deck its underside support and sheer line. Then lower the unit into the hull. It will take a bit of custom-fitting to seat it properly at the bow. This involves beveling the deck edges inward at the bottom, to conform to the bow curve.

After fitting the deck, lift it out and scribe the plate seams as indicated in the plan. Finish all exposed deck surfaces with sanding sealer and two coats of pale green enamel.

Cabin-unit assembly. Basically, this consists of four blocks cut from 1 1/8"-thick balsa, and a pair of sides made from double thicknesses of 1/8" sheet balsa. Laminating the sides is the easy way to fabricate the promenade-deck window recesses without carving or routing.

When you shape the four 1 1/8" blocks, don't taper the curved sections until these parts have been cemented together. Carve a setback just below the rim to support the top deck. Cut the louvers just below the deck with a razor blade, drill all portholes, and insert eyelets. Make doors from three-ply Bristol board. Cut a slot for the bridge-window visor. Cement it in place.

Next, cut and join the two sections of each side wall. Before cementing these

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Full-Size Plans Are Available ...

FOR molding the hull of your model of the Savannah, as described in last month's issue of POPULAR SCIENCE. Send five dollars (\$5) by money order or check to Henry B. Comstock, 334 North Greenbush Road, Blauvelt, N.Y.

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to the block assembly, drill holes and install porthole eyelets.

After sealing and sanding the whole cabin unit, give it two coats of white enamel. After the second dries, paint decks, doors, and the promenade-deck window recesses pale green. Give the bridge window area a coat of black enamel. Rule white lines on strips of acetate to simulate sash, and cement these strips over the painted window sections.

Smaller deck assemblies. Cut the short lifeboat-deck extension from 1/8" balsa and cement it in place. Add balsa-strip coamings at the rear and for the stair wells. Seal and paint.

The reactor observation deck and sports deck are built the same way. But these are not cemented down. By making

Hull—from Newspapers

seal it. Over this apply a coat of auto-body primer, sand smooth, and paint the hull white.

USE CLAY OR A SOFT ERASER to press the paper into depressions such as the hawsepipes and bilge keels. Lay in thin strips first to build up the material at these points.

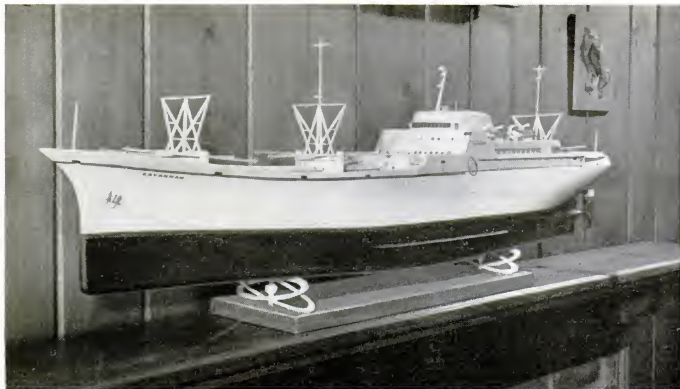
Complete the paper hull just as you do the fiber-glass hull. See instructions in the main article.

SEPARATE THE MOLD HALVES after allowing an overnight drying period. If necessary, pry the paper hull gently away from the mold, working from both ends. Seal the hull with shellac.



CONTINUED

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HEART-WARMING AS A CRACKLING FIRE on the hearth, your Savannah can look like this when

you set her on the mantelpiece this month. But wait until you see her under steam!

them removable you can get a convenient handhold on the entire superstructure to lift it off.

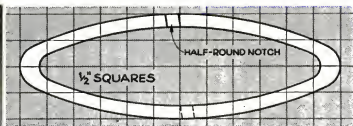
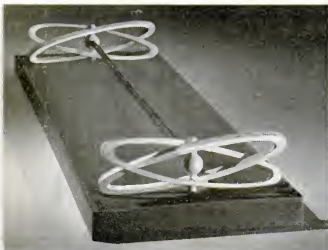
Positioning the cabin unit. You're now ready to attach this to the main deck. Set the deck in the hull, blocking it to the correct height. Position the cabin unit, with its sides inserted in the depressed section of the hull's top edge. Mark its location on the deck and remove both parts; glue them together, using the markings as a guide. Now you can replace the deck whenever you wish, and the cabin-unit sides will hold it at the correct height.

Deck houses, hatches, docking bridge. These are built-up balsa assemblies. Cement their parts together and install

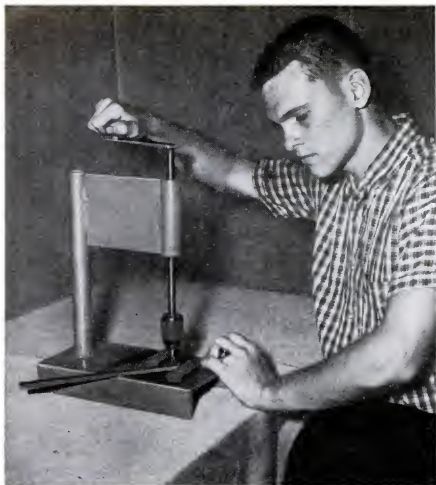
porthole eyelets where indicated. The bridge fittings are brass turnings, soldered where necessary. Use a miniature binding-post nut for the binnacle, a tiny spur-type lock washer for the wheel.

Lifeboats and davits. Savannah has only four boats; two are motor launches. Whittle and sand to shape; then cut the one-piece keel and rudder parts from thin balsa and attach them. Jigsaw the davits from $\frac{1}{8}$ " hardboard for strength and round their lower ends for pin fits into the boat deck. After positioning the davits, tap small brads into the bottoms of the boats, clip off their heads, and insert the resulting pins in holes drilled into the top edges of the cabin-unit sides.

[\[Continued on page 220\]](#)



"ATOMIC" BASE shown in photo at left can be built in an evening. The ellipses are cut from $\frac{1}{4}$ " hardboard, notched and crossed around 3" sections of $\frac{1}{4}$ " brass rod inserted in a 1"-by-6"-by-22" hardwood base. The hull-supporting units are spaced 19" apart, with a third brass rod connecting them. Ends are bonded to $\frac{1}{2}$ " maple turnings with epoxy glue.



Short Cuts and Tips

FROM PS READERS

Homemade Tool Speeds Tapping

HOLES can be tapped more quickly and with fewer broken taps with this homemade device. Ball bearings at the top and bottom hold the spindle true, allowing it to turn and slide up and down.—*Earl Allgaier, Arlington, Va.*

▶▶▶ **LENGTHEN** the life of rubber or plastic tips on tubular-metal chairs by inserting a washer the same diameter as the leg into each tip before slipping the tips on.—*M. Krucker, Davenport, Iowa.*

My Most Embarrassing Shop Moment

"How do you like my new coffee table?" asked my neighbor, beaming, as he came over to show me his newest project. He set it down to be admired.

"Looks great," I said, "but I have a surprise for you, too." I held up a shiny new portable circular saw I had just bought.

"Watch me zip through this," I boasted. I slid a sheet of plywood onto two sawhorses, marked a line down the center, and quickly sliced the board in two.

"Gee, that really cuts," said my neighbor.

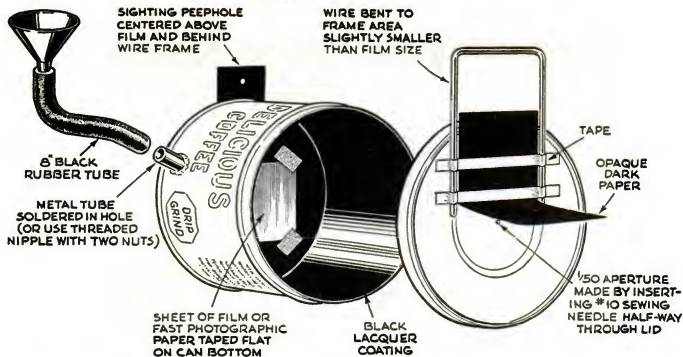
As we pulled the two pieces of plywood apart, there on the ground were the remains of my neighbor's new coffee table—sliced neatly down the middle. In my excitement, I had placed the plywood over the table and had sawed through both at the same time.

Now whenever my neighbor comes over to my shop to show me something, he always makes sure the power is turned off.—*E. M. Bailey, Hessville Station, Hammond, Ind.*



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Do you have an embarrassing shop blunder that haunts you? PS will pay \$50 for each such experience published. None can be returned. Keep it brief. Address: Shop Editor, Popular Science Monthly, 355 Lexington Ave., New York 17, N. Y.

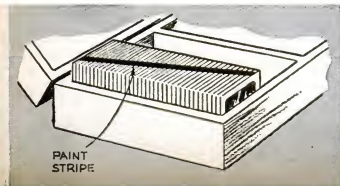


Coffee-Can Camera Develops Its Own Pictures

THAT strange contraption in the sketch above is the latest version of the old pinhole camera. The drawing was adapted from two in a new Kodak booklet for teachers, "How to Make and Use a Pinhole Camera." After you shoot a picture in the one-pound coffee can, the can itself becomes the developing tank.

The can bottom will take a $2\frac{1}{4}$ "-by- $3\frac{1}{4}$ " sheet of film or fast photographic paper. With paper, a sunlit subject will require a two-minute exposure; film takes only a second or two. While pouring the developer and fixer in and out, curve the tube to form a light trap. When not in use, bend the tube and hold it with a rubber band.

GREAT DEPTH OF FIELD is provided by the tiny, lens-less aperture of the camera. The first piano key was only $\frac{1}{2}$ " from the pinhole for this five-minute coffee-can exposure, taken indoors, on Royal-X Pan film.

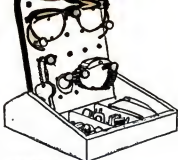


Stripe Keeps Slides in Order

PAINT a diagonal stripe across the top edge of each group in your file box. To replace, shuffle until the stripes line up again.—D. O. Van Gilder, Denver.



GATE-LEG TABLE



DRESSER CADDY



MITER VISE



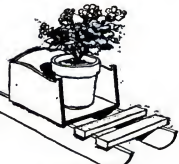
CLOCK SHELF



SHOP CLEANER

Winter Workshop

26 pages
filled with
special projects



FLOWER SLED



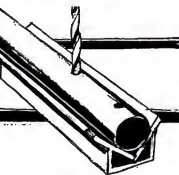
TABLE-TOP BRIDGES



WASTEBASKET



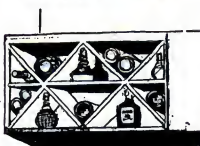
SANDING-BELT HOLDER



VEE BLOCK



DOUBLE-DUTY TABLE



WINE RACK



TREASURE CHEST

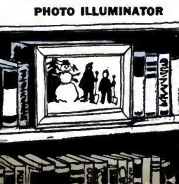
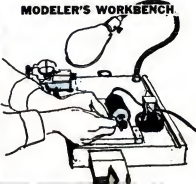


PHOTO ILLUMINATOR



MODELER'S WORKBENCH



TOOL RACKS



TOY BOXES

Workbench for Modelmakers



By W. H. deFontaine

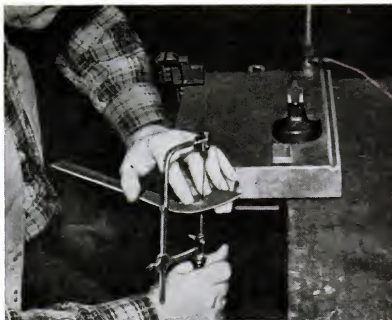
CONCENTRATED into less than a square foot of space, this workbench for modelmaking accommodates nearly every operation that this craft requires. With the anchor block clamped in the vise of a regular bench, the auxiliary working surface is at a convenient height for close work. By providing a socket to hold a gooseneck lamp, you make sure of light where you need it.

The precise arrangement of the various elements may be adapted to your special needs, since a workbench is a very personal thing. The bench shown here has seen me through many a ship model, and there's no reason why—with minor variations—it shouldn't serve the airplane builder, railroader, or architectural modelmaker just as well.

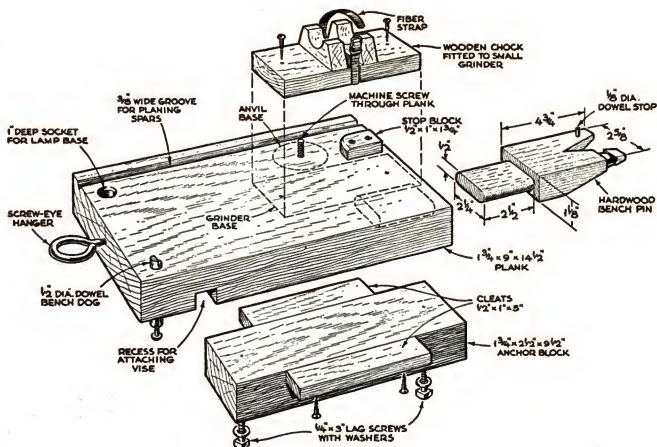
The bench top and anchor block are solid maple, and are lag-screwed together. The weight—about 10 lb.—is an asset; a flimsy bench is of little use in delicate work. If you don't have a shop bench with an attached vise, the unit can be adapted for table-top use by omitting the anchor block and providing a means to hold the bench slab in place with C clamps. In this case, you'll also have to

omit the tightening feature on the adjustable $\frac{1}{2}$ " dowel. As shown here, the protruding bottom end is split with a saw kerf and a wood screw is turned in to expand the dowel; this secures it in its socket at any desired height. The rabbet in its top end helps the dowel serve as a bench dog for planing small pieces.

Another adjustable dowel— $\frac{1}{8}$ " diam—



FRET SAWING of thin metal, plastic, or wood is done with the work laid across the V notch in the projecting bench pin. The dowel stop can be pressed flush when it's not needed.



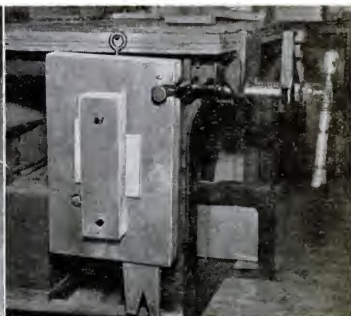
eter—pierces the rear leg of the bench pin. The hole should provide a tight fit to keep the dowel in place, yet permit it to be raised and lowered. That shallow groove on two sides of the front leg serves both as a sawing channel and as another stop. The mortise into which the pin's tenon fits should also be snug. You may want to adjust the pin for special

fret-sawing and filing jobs. For greatest flexibility, no glue should be used in assembling any of the bench parts.

The V groove running across near the back edge nests dowels for planing. All the spars for my models were shaped here. The vise grips round stock for cutting and filing. The stop block at the right serves as a bench hook for sawing.



A PORTABLE GRINDER, strapped into a fitted cradle, leaves hands free for precision work. With a buffing wheel in the chuck, it doubles as a polisher. Like the anvil, it's removable.

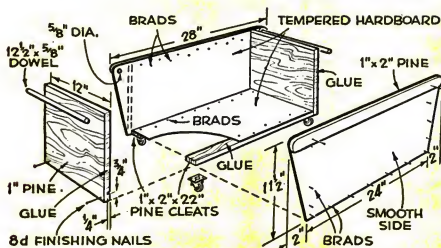


WHEN NOT IN USE, the unit hangs out of the way at the end of the workbench. The optional cleats that flank the anchor block lift the top slab above the surface of the workbench.

Mobile Toy Boxes

MONOGRAMMED toy boxes? Sure thing. Young children soon learn to spot their own initials. The result: Each child stores his toys in his own box. When playtime's over, the boxes can be rolled into a closet.

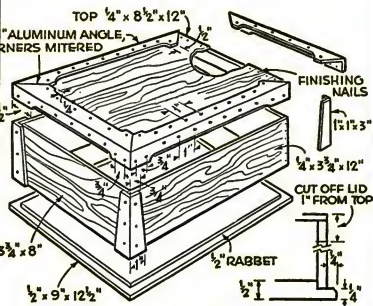
Smooth hardboard sides keep finishing to a minimum—just shellac or varnish the boxes and cover the ends with decorative pressure-sensitive paper. Cut initials from scraps of hardboard. These boxes were designed for the Masonite Corp.



FOR EASY HANDLING, two $\frac{5}{8}$ " dowels are locked into holes on the inner faces of the side rails. Pine ends and one-by-twos add rigidity to the panels of hardboard.

Cook Books Share





Treasure Chest for Prize Chessmen

BBETTER look again if you think those chessmen are housed in an antique metalbound chest created by a metal-smith in the service of long-gone royalty.

The chest actually is a butt-jointed plywood box knocked together with 1" finishing nails and glue. The secret of its beauty is a metallized surface produced by brushing solvent-thinned plastic aluminum over the wood. Aluminum angles fastened to the wood with aluminum rivets hide the butts and complete the illusion of all-metal construction. Cut

and fit the mitered corners of the aluminum angle, and recess the edges before riveting the angle to the lid.

Dilute plastic aluminum with lacquer thinner until it becomes creamy enough to apply with a brush. Don't try to smooth it; a textured finish can be highlighted by polishing with steel wool. If desired, the coating can be tinted by mixing bronzing powder with the thinned plastic aluminum.

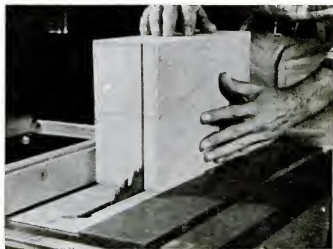
Line the inside of the box and glue felt to the base.—*R. J. De Cristoforo.*

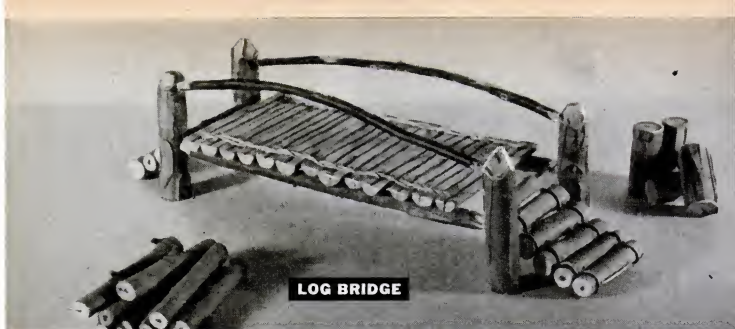
Clock Shelf

THIS shelf brings together two kitchen essentials—cook books and a clock. Cut the bottom, back, and two ends from $\frac{3}{4}$ " plywood or pine. Close off one end to make a box large enough to house an electric clock movement; 10" by 10" should do. The back can be thin plywood or hardboard.

I bought a clock movement from the Hansen Mfg. Co., Princeton, Ind., and cut hour markers from dowels. If you're installing an old clock works and the hands are missing, make new hands from wood or colored lucite.—*Paul Corey.*

SLICE LID OFF after gluing a flat top on the box. Pass each side over the saw blade to cut the lid free. This is easier than making a separate lid, and insures a perfect fit when hinged.



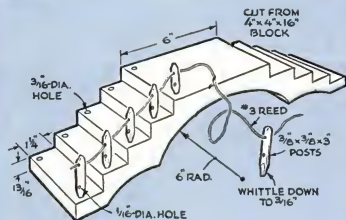


4 Table-Top Bridges

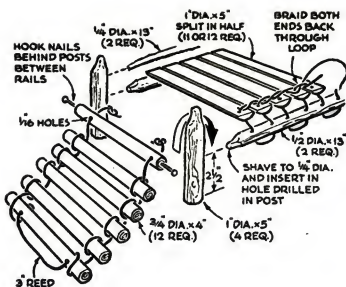


GROUP one of these bridges with rocks and small shrubs to transform a barren section of flower bed into a charmed corner. Indoors, a bridge makes a setting for figurines.

These models can be built at no cost from scrap materials. Rough-finished wood—such as fencing—is ideal for three of the designs. Redwood and cedar are best outdoors; left unfinished, they weather to a rustic color. To accent this realism, work over each piece on a drum sander with a coarse sleeve, wearing off all edges.

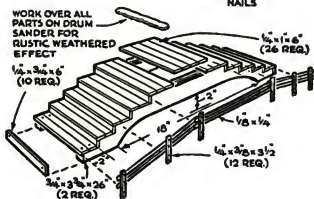


ONE BLOCK YIELDS PARTS for two bridges if you cut all the treads before trimming the risers. Use waste for slab bridge. For variation on rail treatment in photo, drill posts for reed.



PLANK BRIDGE

ASSEMBLY WITH GLUE AND SMALL NAILS



Use them indoors or out for attractive garden displays

The fourth bridge consists of small branches and twigs lashed together with reed. If you want a protective coating, use a clear resin sealer.

The bridges can be scaled to suit any location, from a terraced rock garden to a concrete planter; the dimensions on the sketches are given to suggest proportions. The photographs show all four bridges with railings trimmed from strips that have been sliced off a board on a table saw (or split off with a sharp knife). For a lighter effect, thread No. 3 reed through holes in the posts. Soak it

in hot water to render it more pliable.

The bridges make fine gifts to gardening friends. Our 16-year-old keeps himself in spending money by selling them to flower shops.—R. J. DeCristoforo.

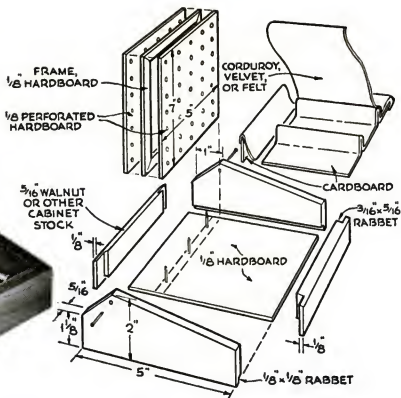


SLAB BRIDGE



ASSEMBLE RANDOM-SHAPED SLABS by joining them with glue and brads. You'll need eight

4"-by-5" steps and one 4"-by-7" platform, plus $\frac{3}{4}$ "-square strips to cut into posts and rails.



Dresser-Top Caddy

LIKE any good caddy, this one carries a supply of golf tees—but it's more concerned with the sandman than with sand traps. As you empty your pockets before bed, it holds jewelry, keys, lighter, and loose change, and keeps them in order while you sleep.

Use prefinished hardboard for the outer faces of the upright sandwich; line up the perforations and glue them to a center

frame. The frame can be made of mitered hardboard strips—or by cutting the center from a third panel.

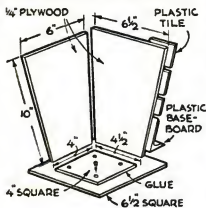
Ten wooden or plastic golf tees of assorted colors, stored in the back compartment, give the angled rack flexibility. If they project through the panel, trim the tips flush. That back compartment also provides a parking place for your wallet.

—Walter E. Burton, Akron, Ohio.

Tiled Wastebasket

THIS sturdy plywood wastebasket makes use of leftover plastic tile and base molding. One pair of tapered side panels is fastened between the other, wider pair with glue and brads. Bevel the bottom edges of this hopper and the edges of the smaller base plate. Glue and brad the plate within the sides. Center the assembly on the larger base plate and drive brads up through this plate into the side edges.

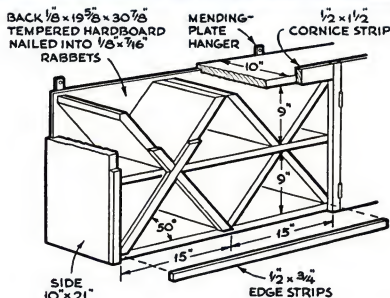
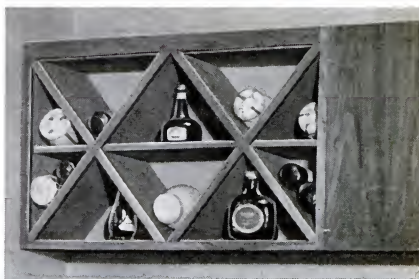
Since the corner joints of the base molding require a compound miter, some trial fitting and filing will be necessary for a professional looking job.—Burl and Thomas Knutson, Bismarck, N. D.



Decorative Wine Rack

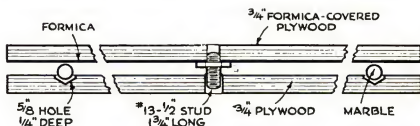
THE triangular compartments of this wine rack make it an eye-catcher for a dining area or built-in bar. The inverted triangles (and the half-bins at each side) take a conventional bottle on its side. The other three compartments are ideal for displaying the unique shapes and colorful contents of liqueur bottles up to 8" tall.

The original rack was made of $\frac{3}{4}$ " redwood with birch strips stained to match. This edge treatment permits use of $\frac{3}{4}$ " plywood. The rack can be built as one section of a running strip of cabinets or as a separate unit; or the partitions alone can be dimensioned to fit an existing cabinet. Built as a separate unit, it can be set on a buffet counter if hanging is a problem. Where possible, space hangers so screws may be driven into wall studs to support the weight of the rack when it is loaded.—Hi Sibley, Nuevo, Calif.



TV Turntable

TEN glass marbles, turning in shallow sockets equally-spaced around a 15"-diameter circle, are the ball bearings for this turntable. The plywood platform they support has its bottom surface faced with plastic laminate or hardboard. Drill all sockets the same depth and wax them with a candle stub after painting both squares to match the table.—Robert Micals, Freehold, N. J.

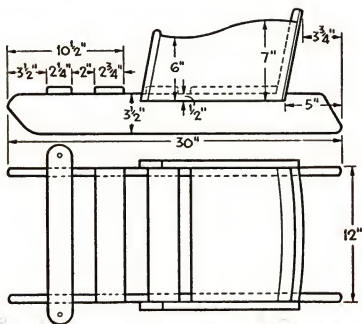




Year-'Round Sled

IN WINTER this little red sled hauls a tot over the snow. Come summer, when other sleds gather dust and rust, replace the tot with a potted plant and put the sled on lawn or patio to add a spot of color to the green.

You can make it in an hour or so. Cut parts from 1" shelving or pine, and join them with glue and screws. Finish with red enamel and add decals or hand-painted decorations on the side.—Robert Hoppough, Chico, Calif.



Transparency Illuminator

TOO often, prize color slides are shown once or twice and then consigned to the limbo of a file tray because the viewing process is a nuisance. Color prints don't capture their sparkle. But a back-illuminated display transparencies made from Ektacolor or Kodacolor negatives.

This one can stand alone on its base or side. But if you plan to insert it into a bookshelf as shown, the rabbeting and mitering of the box can be omitted.





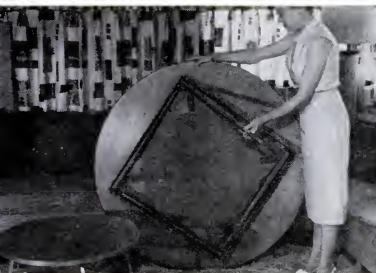
1 LEGS FOLDED, it serves as a coffee table for a corner sofa. Upper disk relieves broad expanse of table's four-foot diameter. Magazines on shelf of base—a small table underneath—needn't be disturbed during conversion.

Double-Duty Table

ONE way to get more use from the space you have is to make furniture do two jobs. This two-level table is an example. Its four-foot diameter makes it a fine coffee table. But it also sets up in seconds as a dining table.

All the parts can be cut from one 4'-by-8' panel of $\frac{3}{4}$ " mahogany plywood. Edges are covered with veneer tape.

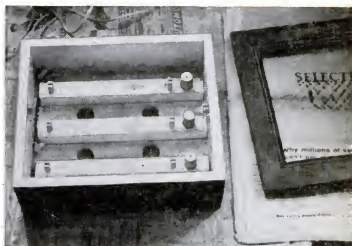
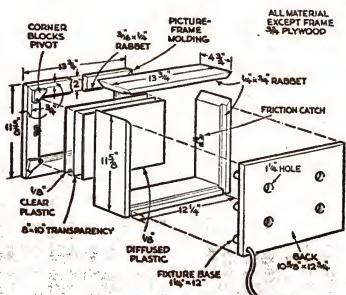
Follow its transition from coffee to dining table in the accompanying photos. —Ruthe S. Waggoner, Sacramento, Calif.



2 TIPPED ON ITS SIDE, it shows how it grows in height. Legs of a card table are screwed to the underside. Plywood disk inside the card-table frame is felt covered to protect smaller table on which it rests when before sofa.



3 STANDING HIGH for dining, it offers ample space for four place settings. Second level now becomes a Lazy Susan that rotates on thread spools set in a smaller disk. Underside of this disk is also felt covered.

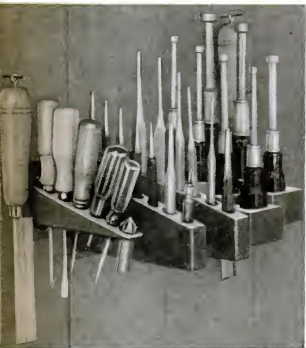


THE FRAME IS REMOVABLE for changing the transparency and replacing the six-watt bulbs. Fixtures are connected in parallel with three wire nuts. Coat inside with white gloss enamel.

5 Shop Gadgets

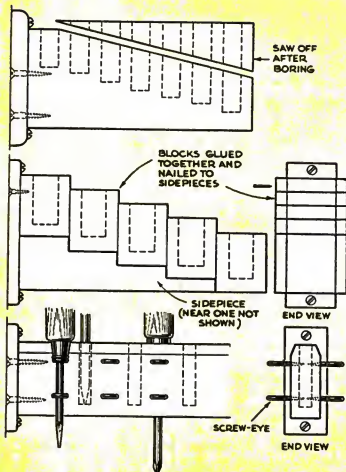


Space waster: 210 sq. in., 20 tools.

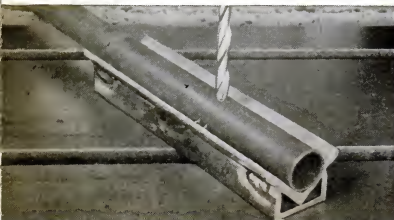


Space saver: 144 sq. in., 28 tools.

Space-saving tool rack. Where wall space is limited, you can store more tools in depth—that is, in racks that project from the wall—than you can in the two-dimensional way. The two photos indicate the space saving. The sketch shows three types of projecting racks. Tools are displayed better if the top slopes downward—about 15 degrees, as in upper two sketches. Screw-eyes can be placed along the sides of either a horizontal or sloping rack.—*W. E. Burton, Akron, Ohio.*



Drill-press V block. Weld a piece of angle iron into a piece of steel channel to make a V block for drilling round material. Cost is so low that you can forget about damage from drill-through.
—*H. J. Gerber, Stillwater, Okla.*



Support stem for dial test indicator can be quickly made from $\frac{1}{4}$ " square stock. Turn down one end for a free fit in the eye of the indicator swivel collar. Mount holder in the slot of a standard tool holder.—*H. J. Gerber, Stillwater, Okla.*



You Can Make

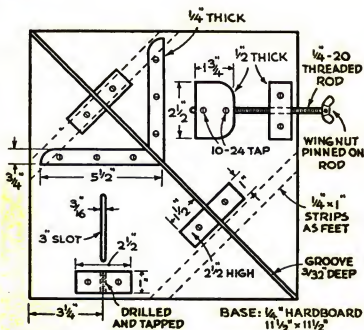
A miter vise for picture framing will practically put you into the business. You use it for both cutting and assembling the picture molding.

Materials for the vise can probably be found in the scrap box. I made the base panel of hardboard; the frame guides, vise jaws, and screw blocks of hardwood. The vise screws are lengths of $\frac{1}{4}$ "-20 threaded rod, with wingnuts attached with #16 pins.

A saw kerf $\frac{3}{32}$ " deep was cut diagonally across the panel on the power saw to serve as a bench mark for frame assembly. Positioning the guides is critical; their placement determines the accuracy of the miter cuts.

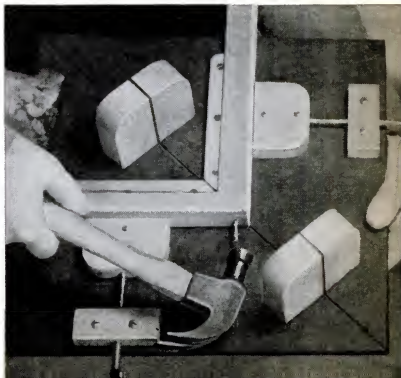
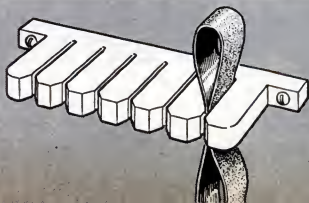
The vise blocks were drilled with a #8 drill and threaded with a $\frac{1}{4}$ "-20 tap to accommodate the vise screws. Then the blocks were bolted securely to the panel. Jaws were drilled with a #23 drill and tapped 10/24 for machine screws that are screwed up from the underside of the panel, through $\frac{3}{16}$ "-by-3" slots, and into the jaws. These screws have washers to permit an easy sliding adjustment of the jaws.

Use a fine-tooth back or dovetail saw to cut molding. In the nailing and gluing process, first make up two angles with the longer molding at the left. Then assemble the two angles into a complete frame. Apply glue on both ends and clamp securely in the vise for final nailing. Rub the first glue coat into the wood and apply the second coat generously to both parts.—*T. E. Halldorson, Evanston, Ill.*



1. Miter the molding . . .
2. Then assemble it.

Bracket for sanding belts. You can keep sanding belts handy on the shop wall by inserting a selection of them in this bracket. Make it of plywood, spacing the slots to keep the belts separated.—*G. E. Hendrickson, Argyle, Wis.*

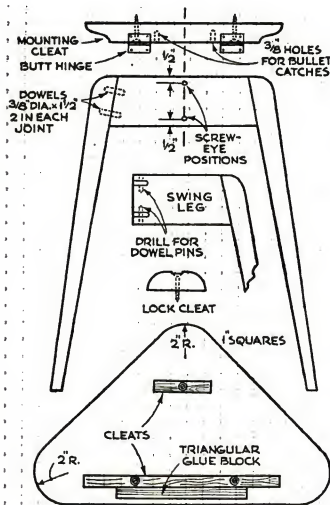


Gate-Leg Serving Table

THE familiar gate-leg principle permits this little table to fold flat for storage. Several kept handy in a closet are a help when serving refreshments. They can also be used as smoking or plant stands and bedside tables.

Make the top of $\frac{1}{2}$ " plywood. You can lay out four tops on a 24"-square panel by scribing diagonals from corner to corner. The other parts are 1" hardwood. Attach the cleats to the underside of the top with glue and $1\frac{1}{4}$ " No. 7 wood screws. Depress the bullet catches for a tight joint by pushing down on the leg while you attach the hinges.

Cover the plywood edges with wood tape if you plan a natural finish. One of the models shown is lacquered black, with the edge of the top gilded.—Bob Johnson, Lakewood, N. J.



SCREW-EYES PROTRUDE different distances: top one $\frac{3}{4}$ ", bottom one $\frac{7}{8}$ ". This cant the double leg about 1" for better stability. The single leg pivots on $\frac{1}{4}$ " dowels, 1" long.



SURFACE-MOUNTING of light butt hinges gives rigidity. Cleat is strengthened by glue block. Bullet catches provide tension to lock swinging leg into groove in front cleat.

Getting Full Use from a "Cut-Off" Saw

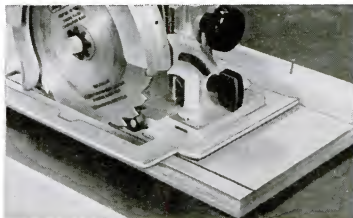
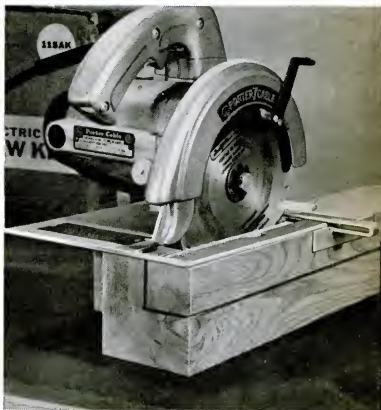
Winter Workshop

ADVICE FOR TOOL USERS—8 PAGES

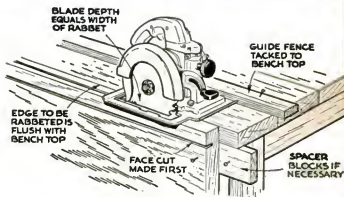
ABOUT 35 years ago the Skill people made tool history by introducing the portable circular saw. Since then, this kind of saw has gained wider and wider acceptance. But many owners still tend to type it by calling it a cut-off, utility, or builder's saw—indicating that they think of it only in connection with construction work. True, it was originally developed to trim framing timbers to length on the job. But with a little know-how and a few jigs, you can broaden its use until it nearly matches the performance of a bench saw. It can

Rabbets can be cut quickly on heavy stock or thin panels

STANDARD RIP GUIDE is all you need to rabbet a timber like the one at the right. Hold the tool level throughout each pass, supporting it firmly when you come to the end of the cut.



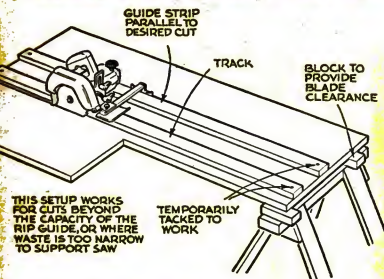
WHERE THE GUIDE WON'T WORK, make the first pass with the saw riding against a strip tacked to the face of the panel. Here, the blade is set to cut the depth of the rabbet.



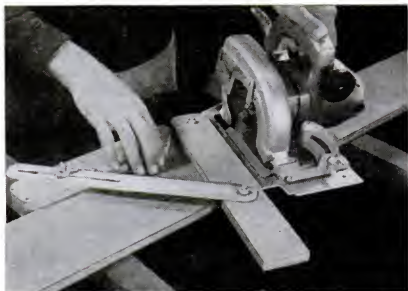
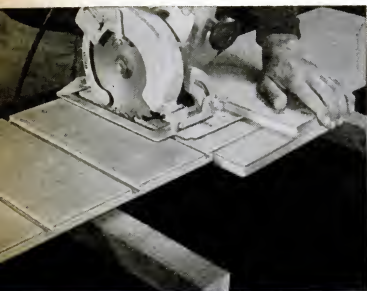
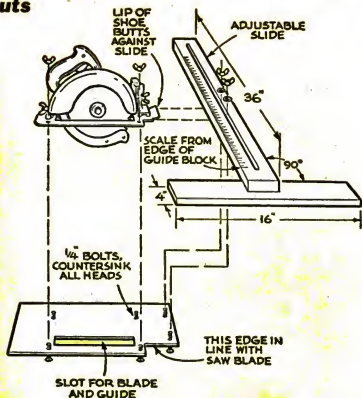
MAKE THE SECOND PASS with the work clamped or tacked vertically to the front of your workbench. The guide strip is now fastened to the bench top, and blade is set for rabbet width.

CONTINUED 171

Setups for making extra-wide rip cuts

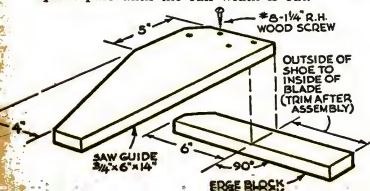


RIP CUTS BEYOND REACH of the standard guide can be accurately made if you ride the shoe against a fence tacked or clamped to the face of the stock. If your saw's shoe doesn't project outside the blade, and its motor housing is too low to clear a fence, use the setup above.



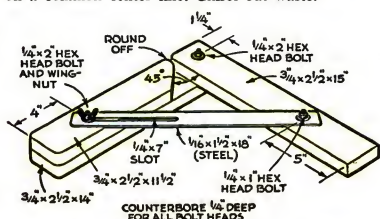
Dadoes need a crosscut guide

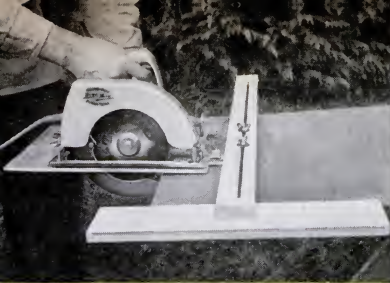
REPEATED PASSES with a conventional blade will cut dadoes of any desired depth. But you need a simple T-square crosscut jig. When cutting the edge block to size, let it extend from the saw guide farther than indicated in the sketch. The first time you use the jig for a full-depth cut, run the saw on across the block. Thereafter, line up this trimmed end with your layout line to position the tool accurately for crosscuts or dadoes. Cut dadoes by moving the guide the width of the kerf for each subsequent pass until the full width is cut.



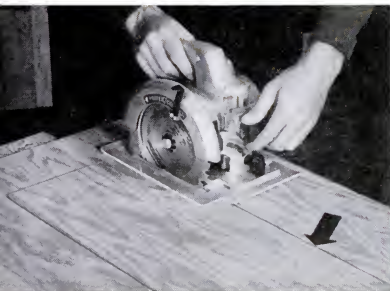
Jig adjusts for angle cuts

ADJUSTABLE VERSION of the crosscut jig lets you cut off (or dado) at accurate angles. This one has automatic stops at 45 and 90 degrees. If you often cut angles between these, mark intermediate locations beside the slot. To make the slot, drill the hole that establishes a right angle between the arms, then a series of holes on a common center line. Chisel out waste.



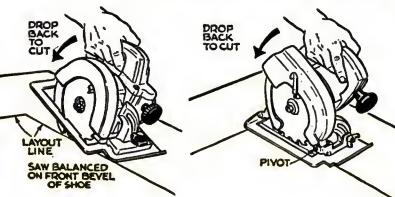


JIG FOR WIDE RIP CUTS can be made from three pieces of scrap, as shown in the sketch at left. Check the assembly carefully with a try square to make sure the blade will move parallel with the bearing edge of the guide block when the saw is bolted to the plate. If you provide the slide bar with an accurate scale, you won't need layout lines on the stock.



Inside cuts with any make saw

CUTS WITHIN A PANEL are easily made, whatever the saw design. If the shoe has an up-turned front edge or is attached with a pivot, tip the saw forward, as shown in the sketches. Turn it on and drop it back. If the saw has an elevator-type depth adjustment, line the retracted blade up with the layout mark (arrow above), sink it into the work while it's turning.



easily cut rabbets, dadoes, bevels, compound miters, and identical pieces for production work. And it can do things a bench saw can't—such as chopping up large stock that's clumsy to balance on a saw table, or chasing itself around a circle. Whatever its job, it has one special advantage: You can tote it—along with the jigs—to the work site.

Even ordinary cut-off and ripping jobs can be done more accurately if the saw is used with a fence or track. Guided only by hand, the blade can be led astray by crossgraining and tough knots, and it's particularly hard to keep on the line at the end of a cut, when the guide notch at the front of the shoe is no longer riding the stock. It's the difference between drawing a straight line freehand or with the help of a ruler.

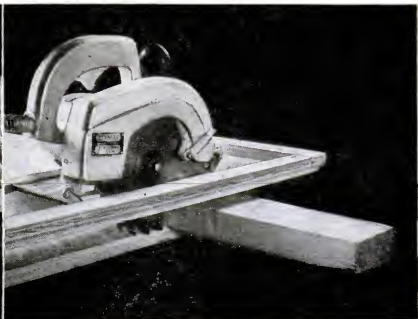
The photos and sketches on these pages will help you realize the full potential of your saw. Where jigs are involved, build them to last, using a good grade of lumber or exterior plywood. Assemble the permanent joints with waterproof glue. Sand off sharp edges and apply several coats of a resin-type sealer.

Together with commercial accessories that convert the tool into a bench, saber or chain saw—or a planer—these jigs should keep your saw on the active list.



Circle cuts on thin panels

RADIUS GAUGE is a strip of wood or metal fastened in the rip-guide slot and pivoting on a center nail. The kerf is really a "cove" cut, so don't force the saw or attempt small circles. Make the cut in stages, lowering the blade 1/16" to 1/8" for each new pass.



TRACK-AND-BED JIG can be used for trimming individual pieces, as here, or for gang-cutting up to five two-by-fours. Dimensions in sketch (far right, top) can be extended for larger

capacity. Position the work in the bed and tack the track across the trim end, aligning the slot by butting the projecting blade flat against the edge of the bed, as shown above.

EVEN standard cut-off jobs can be done more accurately with jigs. The track-and-bed setup can be used at the building site, as well as in the shop.

To trim several pieces to the same length, line up their square ends within the bed, at the proper distance from the trim edge past which all of them project. Temporary stops, nailed across the floor

of the bed, help in cutting duplicate pieces such as fire stops and braces. Tack the track in place with its slot directly above the trim edge.

The adjustable production jig is for duplicating a cut of any given angle on as many pieces as you need. Since this jig lies on top of the work, blocks are required for blade clearance. You can

The Cut That Couldn't Be Made with a Circular Saw

"MAKING kindling of that TV cabinet, Jim?" Flushed with effort, Jim turned from his work, a keyhole saw in his hand.

"Oh, it's you, Tom. I'm just sawing out this shelf the chassis stood on. We have a new TV, and I'm converting this to a speaker case for my hi-fi."

"Good idea. But why use that handsaw, with your portable circular saw lying right next to you?"

"I used that to cut the right end of the shelf free, close to the wall. But I can only work from the open back, and since the blade's on the right side of the motor, it can't cut closer than about six inches from the left wall."

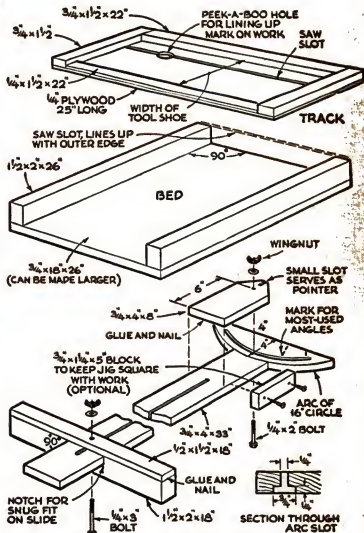
"Hm, I see that," said Tom. "But what'll you bet I can use that power saw to cut the left end as close to the wall as you did the right?"

Could he? How come? (Solution on page 212)

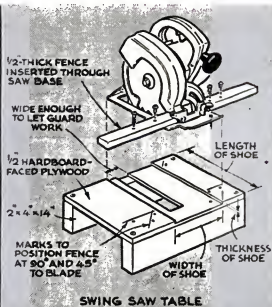
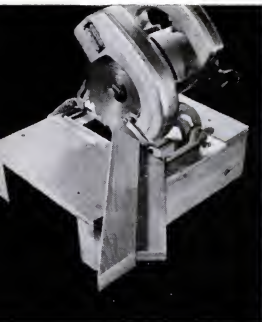


cut several pieces at a time by stacking them—within the limitations of your saw's blade depth.

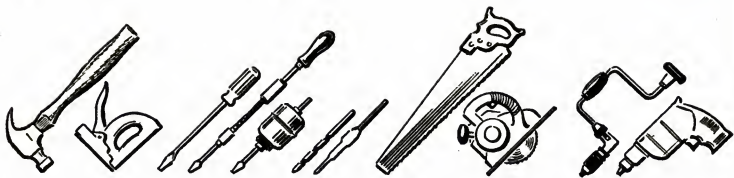
Cut the pivoting guide first and use it as a template in laying out the mating curve on the length gauge. To be sure this piece parallels the work, attach a side block to provide a lip that bears against the edge of the board to be cut.



ADJUSTABLE PRODUCTION JIG



bevel. With both blade and fence set at an angle (not shown) you get a compound miter. In photos, guard is locked away, but it will function normally. With a hollow-ground blade, this setup is hard to beat for accurate, ready-to-assemble miters—especially on shaped moldings.



How Fast Do You

By George Daniels

THE question above is a good one. Maybe you aren't the craftsman you think you are. Maybe you've been using the wrong tools. Maybe you've been using the right ones badly. Maybe you need a batch of better tools.

These were some of the speculations I had about my own work when I timed myself on a few typical jobs. Not that I wanted to become a speed demon—shopwork should be relaxing. But the

What the Pros Can Do

HOME craftsmen aren't out to match the pros in speed, but the amazing feats accomplished by experienced workmen show how far simple efficiency can go in saving hours of labor. Here are a few examples.

One skilled workman can:

- Lay 500 square feet of hardwood flooring a day.
- Insulate a six-room house in four hours.
- Build a 4'-by-4' movable shelf unit in 15 minutes.

With a partner, he can:

- Frame a 40' wall in five hours.
- Sheath the same wall with plywood in 1½ hours.
- Build a car port in two days.
- Complete a one-car, drop-siding garage in five days.

more efficient you are, the lazier you can be.

Take the difference between a tack hammer and a stapling gun. I timed myself and found I could drive about 20 light nails a minute with the hammer, but 60 staples with the gun. I knew, of course, that stapling was fast, but I never realized just how fast.

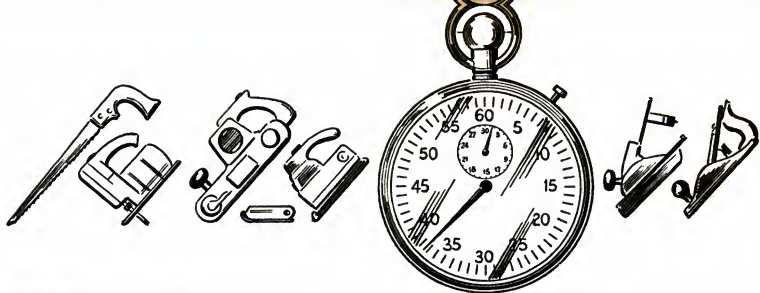
The result gave a friend of mine a timesaving idea for shingling a summer cabin. Instead of nailing the shingles, he decided to whack them on with a stapling hammer and cut the time in half.

Picking the right tool. Knowing how fast different tools do the same job helps you select the best one. It also helps you decide which new tools would be a worthwhile investment for the kind of work you do.

If you've been wondering, for instance, what a screwdriver attachment for an electric drill might do for you, you'd be interested in this test. Using an ordinary screwdriver, I found it takes 18 seconds to drive a 1¼" No. 10 flathead wood screw in a predrilled pilot hole. A power-screwdriving attachment for a drill will punch in the same screw in about two seconds.

On small jobs, the saving in seconds may not mean much—in fact, it may take longer to get out the drill and set it up than to drive half a dozen screws by hand. But on sizable jobs, such as assembling a boat kit or a hi-fi cabinet, the difference can add up to a full day's work in fastenings alone.

Here's another tip: You'll find that a spiral-ratchet screwdriver can sink a No.



Work with Tools?

10 screw in $4\frac{1}{2}$ seconds—not as fast as a power attachment, but four times faster than a hand screwdriver. On medium-size jobs, or on big jobs where you don't have access to electric power, the spiral driver is a very good bet.

Timing yourself on tools also exposes a common fallacy: Just because you can drive one screw in 10 seconds doesn't mean you can drive 100 in 1,000 seconds, or about 17 minutes. You tire as you go along, especially with hand tools. At the end of a day's work it may take you twice as long to drive the same screw or saw the same board as it did early in the morning. With this in mind, you can plan your work better—shorter sessions may actually save you time.

Boring screw holes. Drilling a separate pilot hole, clearance hole, and countersunk recess with three different bits

is one of the most tedious shop jobs. Even with a power drill, it takes at least six seconds per screw, not counting the time required to switch bits. By using a combination bit that does all three jobs in one operation, you cut the time to two seconds per screw. On that boat kit, this can add up to a saving of several hours.

Oddly, few people seem to think of using a combination bit in a hand drill. Yet I found that you can sink a three-step hole in $4\frac{1}{2}$ seconds with this trick—actually faster than using a power drill with three separate bits.

Saving. Differences in sawing time are even greater. With a good handsaw, you can rip 1" pine stock at about 8' a minute and cut through a fir two-by-four in 12 seconds. Using a portable circular saw, you can slice the same pine at 30'

[Continued on page 222]

How to Be Faster

IN ADDITION to selecting the proper tool for the job, you can improve shop efficiency by following a few simple rules:

- Arrange tools and materials for greatest convenience before starting work. Walking the length of the cellar to get a handsaw takes as much time as sawing a two-by-four.

- Make duplicate parts in one batch—not individually as you need them. You'll not only save time, but improve accuracy.

- Plan for minimum tool changes. Your $\frac{1}{4}$ " power drill can bore five pilot holes in the time it takes to switch bits.

- Don't rush. Statistics show that errors increase when you exceed your normal working rate.

- Don't fret about mistakes. If you pull a boner, you're in professional company. Top-ranking woodworking shops plan their time schedules to allow a 5-percent margin for working errors on simple jobs and a 10-percent margin on complex ones.

Workshop Tips from PS Readers



Keep That Blade Clean

GUMMY sap builds up on a power-saw blade and causes burning and rough cutting. So wipe it off frequently with a rag soaked in shellac solvent or other alcohol. The same trick is good for hand-saws.—*R. Hertzberg, Douglaston, N. Y.*

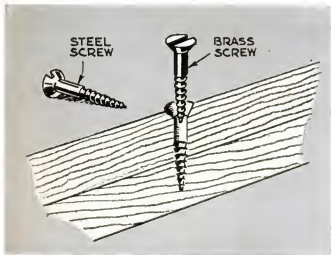
How to Save Old Files

YEARS ago an old-timer gave me this tip: When files seem worn out, dip them in a strong solution of sal ammoniac (as at right) and throw them out on the grass for several days. Turn them from time to time until they develop a good coat of rust. Then brush off the rust with a file card—and you're in business.

I'm now an old-timer myself and glad to pass on the tip. It really works.—*E. Loyd Enochs, Modesto, Calif.*



▶▶▶ **USE** a wood rule around power equipment. A steel rule or tape may catch in the tool, causing damage or injury.



Use Care with Brass Screws

EXPERIENCED cabinetmakers know that too much torque may break brass screws being driven into tough wood. So they first drive a steel screw of the same size, remove it, and then drive in the brass one.—*Ken Murray, Colon, Mich.*



Keep Small Parts in a Tray

WHEN my wife threw out a set of plastic ice trays, I salvaged them for use in my shop. They do a fine job of keeping small parts separated when I'm taking apart such things as clocks, radio, or my TV.—*W. H. McClay, Pasadena, Calif.*

Portable Sander Does a Quick Change

Winter
Workshop

NEW TOOLS—8 1961's
PAGES

YOU can now have a portable belt sander and a bench sander in the same tool. The new Craftsman 4" belt sander below can be used freehand or clamped in an accessory stand for stationary use. You can mount the stand

in several positions on a bench or wall.

A 6' accessory hose also lets you hook the sander to a household vacuum cleaner or a shop vacuum for dustless sanding. The tool is sold by Sears, Roebuck, 925 S. Homan Ave., Chicago.



FOR A TABLE SANDER, you mount the portable tool in a metal stand and clamp it flat to a bench with bolts and wingnuts. Sander sells for \$64.95, the accessory stand for about \$13.

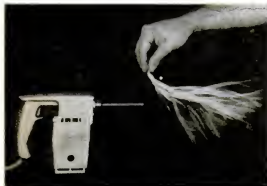
FOR VERTICAL SANDING, you just turn the bench stand up-right and clamp it with the same wingnuts. The sander will grind metals and sharpen tools, as well as shape wood.

FLUSH-MOUNTED on end of the bench, sander is kept conveniently out of the way; bench can help steady large work. The vacuum hose plugs into back of sander, sells for \$7.98.



SHOP-USE REPORT on the

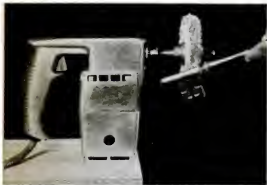
By R. J. De Cristoforo



THAT'S A REAL BREEZE you get from the chip blower built into this new Disston drill. When you drill dusty materials that you don't want blown around, you can shut the blower off.



SIGHTING DOWN that long, flat top on the drill is a big help in steering the bit in a straight line. Note how the blower keeps the holes completely clear of annoying sawdust.



THAT STAND-UP BASE is a natural for buffing, sanding, and wire-brushing operations like this. For added rigidity, drill can be bolted to a wood base through holes in the bottom.

YOUR first glimpse of Disston's new $\frac{1}{4}$ " drill may cause you to wonder: "What, a paint sprayer?" You quickly see, however, why the unusual design makes sense. With your hand directly behind the bit, you can drill straighter, apply more muscle on tough boring jobs, and eliminate the wobble that breaks bits and gives you oval holes.

Set the drill down and you begin to appreciate that wonderful stand-up base. Drill bits, held up out of harm's way, aren't broken when you bang the drill on a bench. Pick the drill up and it's in an upright, ready-to-go position. The stand-up base also makes it easy to use the drill to power sanding drums and other accessories.

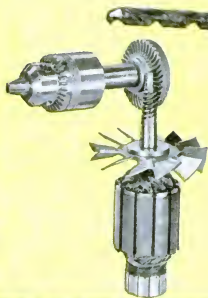
What's the secret behind the new design? A unique right-angle drive using spiroid gears that manage the entire speed reduction in one stage. Previous attempts to turn the corner with worm and bevel gears proved too costly. Disston's price (around \$30) is one result of the sturdy spiroid design, which does away with two-stage reduction and permits use of less expensive sintered gears.

The offset motor and recessed chuck give the drill's working end the slimmest profile in the business. You can sneak it into tight corners and drill closer to obstructions than with conventional drills. The drill is rated at three amps and turns at 1,800 r.p.m. It's made by the Disston Division of H. K. Porter Co., Philadelphia, and is expected to be generally available within a few months.

RUGGED CUTTING JOBS, such as slicing $2\frac{1}{2}$ " holes in hard-board-surfaced plywood, come easy to the new drill. It won't stall if you let cutters take their own bite.

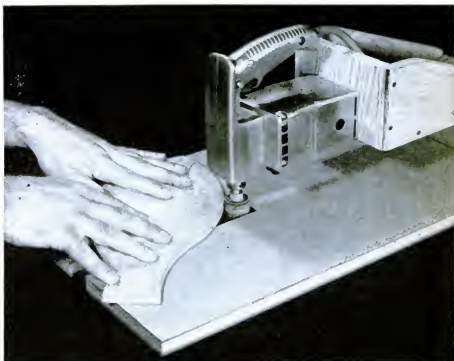


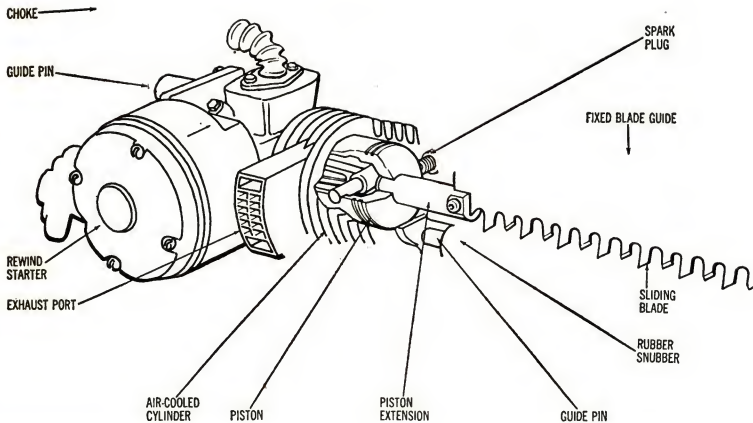
New Disston $\frac{1}{4}$ " Drill



SLIM PROFILE and offset motor housing let you drill closer to obstructions and reach farther into corners. Bit at right, above, shows clearance required by conventionally shaped drills.

UNIQUE RIGHT-ANGLE DRIVE makes possible this new look in drills. Slide pointed out above closes chip blower when not in use. Drill becomes drum sander when mounted as below in a homemade stand.





Swiss Vise Holds Down Many Jobs



ODD-SHAPED WORK of almost any size can be easily held in this multiposition Swiss vise. Its jaws can be set up as a conventional vise, as above, giving an opening up to 8". Or one jaw can be removed and clamped separately anywhere along the bench to handle extra-long work up to full-length doors.

The Inside Story of the New Wright Saw

YOU don't need a crankshaft to deliver power from a gasoline engine. The proof is this new small version of the Wright reciprocating saw. The piston drives the blade directly, giving added speed and punch to the cutting stroke. The saw's designers believe this is the first time this principle has ever been used.

The blade is hooked solidly to an extension on the piston that passes through a hole in the cylinder head, as shown at left. Each firing stroke of the piston is the cutting stroke of the blade. Five cast-iron rings—like tiny piston rings—seal the hole in the cylinder.

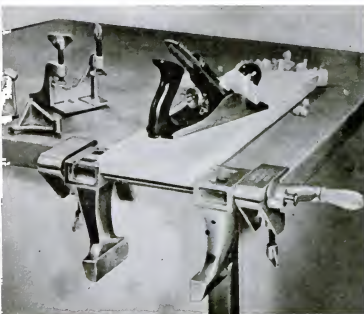
The increased power and reduced friction of the direct drive permit use of a

smaller, less expensive engine. The saw's weight is slimmed to 19 pounds; and price is down to about \$130.

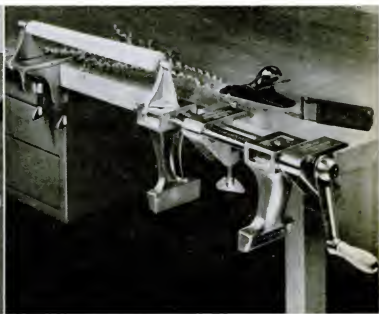
The new saw had its problems, though. The weight of the blade attached to the piston set up teeth-jarring vibrations. This was overcome by floating the engine

on guide pins, permitting it to vibrate without transmitting the shock to the operator. Connecting the moving engine to a fixed carburetor called for another trick: A rubber bellows serves as a flexible intake manifold.

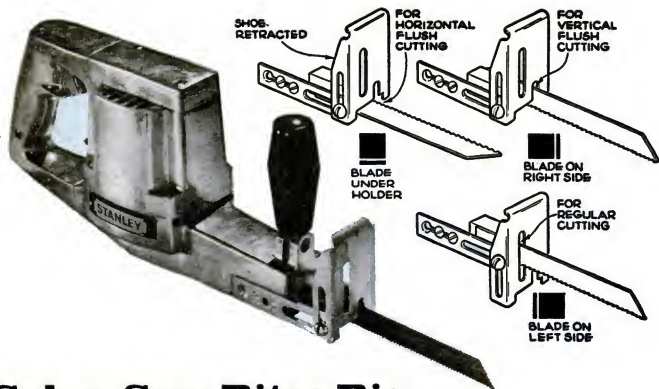
The new Model 2016 Wright Saw, designed for construction work, tree felling, and heavy timber cutting, is made by Thomas Industries, Inc., 207 E. Broadway, Louisville, Ky.



WITH JAWS TURNED UPSIDE DOWN, boards can be held flat between the square bases. For vertical setups, the work is gripped by both the jaws and bases for added rigidity. Soft-jaw inserts are also included for delicate work.



EXTRA POINTED JAWS, acting like lathe centers, let you rotate round or tapered stock for uniform shaping. The vise is sold in this country by Little Wonder, Inc., 1028 Street Road, Southampton, Pa. The price is \$21.90.



Saber Saw Bites Big

YOU can cut up to 10" deep with this heavy-duty, long-bladed saber saw. It chews either wood or metal. An ingenious adjustable shoe and three-sided blade holder make it possible to mount the blade in any of six positions for cutting in any direction. With the shoe retracted, the blade is flush with the base of the

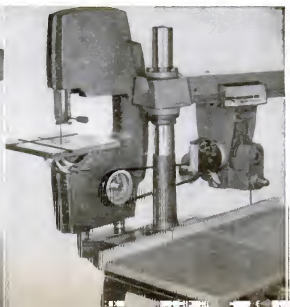
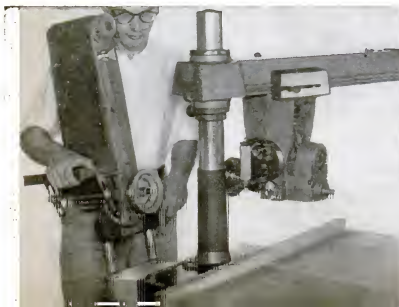
saw so you can cut right up to obstructions either vertically or horizontally without the saw getting in the way. Made by Stanley Electric Tools, New Britain, Conn., the saw is rated at five amps, weighs eight pounds. It has fast and slow cutting speeds to suit different materials. Price is \$89.50.

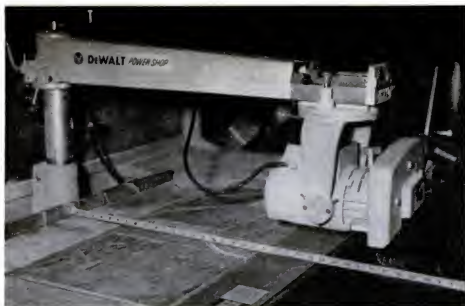
Radial Saw Becomes Five Tools

BORROWING an idea from the multipurpose Shopsmith, the same makers have now come up with a multipurpose radial-arm saw, called Sawsmith, that converts to four other tools. The new saw will power a belt sander (below, left), a bandsaw (right), a jointer, and a paint-sprayer compressor. The four tools, which also fit the Shopsmith, slip into a bracket on the back of the saw and

are driven by belt from the saw's motor.

Also new on the saw are a slide-out table that simplifies fence adjustments, a reversible blade arbor that can be mounted on either side of the motor, and a selector that gives you seven motor speeds. Made by Yuba Power Products, Inc., 800 Evans St., Cincinnati, the basic Sawsmith saw sells for about \$240. The adaptor bracket is about \$6.





Radial Saw Gets Its Arm Stretched

THIS extension track adds an extra 6" of reach to DeWalt radial-arm saws. It bolts into existing threaded holes in the end of the arm and increases the saw's capacity to 30½" on rip cuts and 25" on unobstructed crosscuts. The track is sold for \$19.95 by Home & Industrial Tool Distributors Co., 27 W. 46 St., NYC.



Baby Drill Fits in Tight Spots

ONLY 7" long, this midget electric drill fits in the palm of your hand yet has big-drill capacity in its ⅜" chuck. It weighs three pounds. Designed for easy handling and storage in small spaces, the 1.75-amp Speedway drill is made by Thor Power Tool Co., LaGrange Park, Ill. It's priced at about \$22.



Neat Joints for Metal Molding

METAL channels for counter edging and raceway wiring are easy to cut and join accurately with this hacksaw guide. It has slots for both 45- and 90-degree cuts. Two sizes take channels up to 35/64" wide (\$2.50) and up to 1" wide (\$2.75). They're made by the National Electric Products Co., Gateway, Pittsburgh, Pa.



Drill Becomes a Tapping Tool

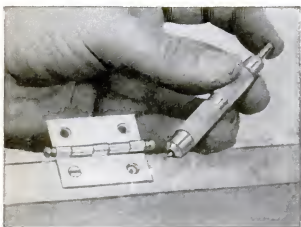
THIS low-cost tapping head turns any drill press or electric drill into a tapping tool. It's said to tap up to 350 holes an hour. The planetary-gear head has a hand clutch and can be reversed for removing taps. Reduction is 5:1. For drill-press use, a detachable arm locks clutch to column. The tool takes No. 6, 8, 10, and ¼" taps and, with adaptors, will drive screws and nut sockets. It sells for \$13.95 by Babcock Mfg. Co., 5634 Shafter Ave., Oakland, Calif.



Now You Can Shape Dovetail Joints with a Saw Blade

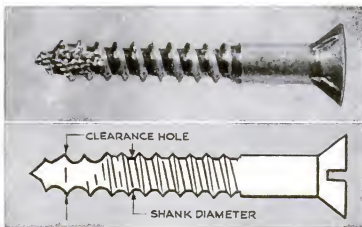
ANY power saw will quickly cut fancy dovetails with this new circular blade. Its teeth are cocked at a 15-degree angle so that when either the blade or the table is set at the same angle, you get a cut that slopes on the side but is flat on the bottom. One pass of the work over the blade cuts half of the dovetail, as at left above. Then the work is reversed

and a second pass completes the shape, as at right. The blade is $\frac{1}{4}$ " thick, 6" in diameter, and comes with a $\frac{1}{2}$ ", $\frac{5}{8}$ ", $\frac{3}{4}$ ", or 1" arbor hole. A right-hand type is available for radial-arm saws and a left-hand one for table saws and most portables. Home & Industrial Tool Distributors Co., 27 W. 46 St., NYC, sells the blade for \$19.95.



Punch Centers Hinge Screws

THE trick in mounting a hinge is to get all screws exactly centered so a crooked one won't pull the hinge out of line. This prick punch seats itself in the hinge holes and automatically marks the center of each screw hole. The punch is spring-loaded and retracts after each prick is made. L. S. Starrett, Athol, Mass.



Screws "Drill" Their Own Holes

You need no starting hole to drive these self-drilling screws. The flattened point spreads wood fibers apart, making a hole larger than the screw shank. Because no wood is removed from the hole, the fibers are said to close around threads to hold them tighter than in a predrilled hole. Reed & Prince Mfg. Co., 1 Duncan Ave., Worcester, Mass., makes the screw.

Winter Workshop EXTRA FREE BLUEPRINT

Build Your Own Shop Vacuum Cleaner

*A 10" blower and cyclone separator
make it a glutton for clean-up jobs
that balk ordinary shop vacuums*

By Phil McCafferty

HERE'S a machine you can build that will plow through shop clean-up jobs with the negligent ease of a bulldozer uprooting a sapling. It's designed to do the whole cleaning job—not just sniff up the dust after you've shoveled up the bulk of the rubbish.

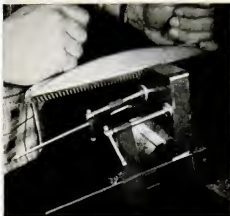
Though it won't quite jerk the screws out of the top of your workbench, there are two elements in this cleaner's design that take it com-

CONTINUED

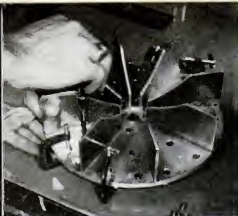
BIG 10" WHEELS let you "walk" your shop vacuum upstairs or down to use its superpower anywhere there's a tough clean-up job. Clean overhead once and you'll rarely have to do it again if you use the vacuum while you work. A big cleanout door makes it easy to empty.



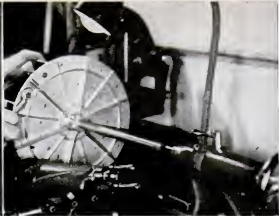
How to make and balance the blower wheel



CLAMP SAWED BLADE BLANKS together and file to uniform shape and size. File blades one at a time to add 45-degree chamfer. Take care to make all eight blades exact duplicates.



DRILL, COUNTERSINK, AND TAP holes for #10-32 flathead screws with blades carefully clamped in place. Use countersunk lock washers and tighten screws after removing clamps.

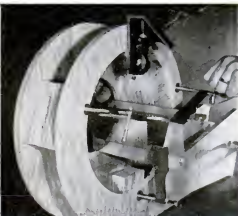


BALANCE THE WHEEL by adding longer screws and nuts to the side that always stops on top when wheel is spun between greased centers. Continue until it stops at random positions.

Blower housing is made of plywood and sheet steel



LAY OUT TOP of blower housing and drive nail through bore center to locate center of bottom piece. Using height of motor-shaft center, lay out motor-base location for later use.



CLAMP BLOWER PARTS loosely with 3" spacers between. Bump pieces into alignment using square as a guide. Clamp tightly and recheck before attempting wrapper installation.



INSTALL FOUR SCREWS adjacent to 90-degree corner and bend wrapper around contour to be sure alignment is okay. Apply sealer and fasten sheet, working both ways from corner.

How to groove top and base of chip drum and assemble



JIG FOR ROUTING grooves, made of two-by-fours, holds $\frac{1}{4}$ " drill square to surface. Spiral results from swinging arcs of different radii from two different centers. Use $\frac{1}{8}$ " router cutter.



TRIM DRUM WRAPPER to length after it has been fitted into the groove and wedged against inside of groove with wood screws. Fasten with screws into the edge of the filler strip.



TACK ON PLYWOOD SCRAPS at several points around inside of groove on the underside of drum top. They'll guide wrapper edge into the groove when top is lowered into position.

pletely out of the class of ordinary shop vacuum cleaners. The secrets of its amazing performance:

- A cyclone separator that extracts most of the rubbish from the air stream before it reaches the fan or filter.

- A 10" blower that provides an air-moving capacity several times that of the usual shop vacuum.

It will nonchalantly suck up practically anything you can get into the 2½"-diameter hose. This includes filter-clogging gook like soot, powdered plaster, and shredded wallboard; and really rough stuff like nails, broken glass, metal shavings, and sand. Short sniff or long drag, it sucks up material with the same efficiency, and it does it whether full or empty. Reason: The design allows less than one percent of the power-throttling rubbish to even get to the filter bag.

The volume of material it will hold is about twice that of the average commercial shop vacuum. Usable capacity is a bit over three bushels. A cleanout door in the drum makes it easy to empty.

The chip drum is rigid steel instead of the usual cardboard. Four-point suspension gives you the stability and mobility you need if you want to lead the machine around by the hose. Large rear wheels let you "walk" it up and down stairs and roll it easily over uneven surfaces.

Many of the parts, fittings, and nozzles are readily available by mail order. Hose is the standard auto-defroster variety.

Centrifugal-separation principle, widely used in mammoth industrial cleaners,

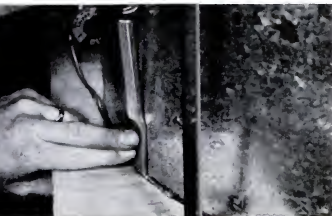
Final steps on the chip drum



POSITION CLEANOUT-DOOR FRAME on the drum; rasp contour to get a close fit between frame and drum. Scribe inside frame; drill 24 7/32" holes around scribed area. Saber-saw opening.

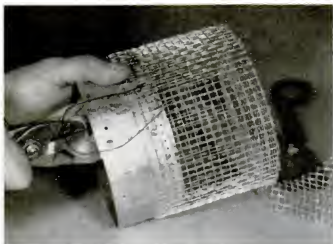


CALK AROUND FRAME and fasten it to drum with 1"-#8 r.h. wood screws with flat washers through predrilled holes in drum. Screw 1½"-#10 f.h. screws through drum bottom into door frame.

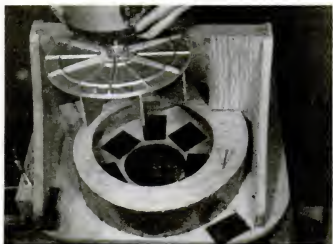


DRIVE ¼" SOLID-CORE SOLDER into the groove, removing wedging screws ahead as you go. Start with the base next to the inlet strip and continue all the way around. Do the same at the top. Calk the joint completely, working the compound into all voids with putty knife.

INSTALL HINGES, sash locks, and gasket on cleanout door. Mount catches for sash locks on frame. Hook up exhaust bag, attach closing clamp to bottom, fit web of aluminum angle under the drum bottom, and drive two finishing nails into drum base through the 7/32" holes in angle.



BEND INLET-PIPE SHEET to 5½" diameter using blower hole in drum top as a form to get it perfectly round. Rivet seam. Make hardware cloth into a tube and add bottom by interlocking exposed wire ends. Join pipe to screen by "sewing" wire through predrilled holes in pipe.



INSTALL BLOWER WHEEL on motor shaft and lower into position. Shim beneath blower blades with ¼" hardboard scrap as shown. Position motor to give wheel equal clearance around hole before scribing holes for motor-mounting bolts. Remove motor and drill mounting holes.



REASSEMBLE BLOWER WHEEL on motor shaft with blower-wheel cover in place. Tighten wheel set-screws firmly. Bolt motor down. Rotate wheel by hand to check wheel clearance. Position cover for hub clearance and drill into blower housing for ¾"-8 roundhead wood screws.

is the basis of the cyclone separator design. Those big babies are used to clean up foundry sand, steel blast shot, welding slag, and boiler-flue accumulations; and for central waste-disposal systems and similar tough jobs.

How does it work in this machine? A blower, mounted on top of the cleaner, creates a high-velocity air flow into the intake hose through an expanding circular passage in the chip-separation drum. Blower exhaust is into a large cloth bag that acts as an air diffuser and secondary filter. The bag may seem over-size, but there's a good reason for making it big: A large volume of air must be dissipated rapidly to avoid power-robbing back pressure.

Material caught up in the nozzle's rapid air stream doesn't have a chance once it enters the swirling circuit through the drum. Centrifugal force slings the material against the side of the drum, where it falls harmlessly to the bottom. According to Bernoulli's Theorem, the chip-laden air, traveling at high velocity and low pressure through the hose, slows down rapidly as the relative pressure increases inside the drum. The remaining chips simply drop from running out of steam.

A screen protects the blower inlet to keep damaging chunks from being sucked into the blower if the machine should be operated beyond the drum's capacity, or if it is run without a hose. The latter condition sets up turbulence in the drum.

The vacuum producer for the cleaner is a big 10" centrifugal pressure blower. It does its job by rapidly increasing the velocity of the air captured between the blades as it whirls the air centrifugally toward the tips. The tip speed is 9,250 feet per minute. The velocity increase causes a severe pressure drop, or vacuum, at the intake.

A commercially made blower can be used by adapting the mounting arrangement to fit. But, unless you can find a bargain in a used blower, the prices of new ones make it worthwhile to build your own. The homemade blower is designed to use all the power a ¾-hp., 3,450-r.p.m. motor should be called on to supply continuously. Before you buy a motor, make sure that it is recommended by the manufacturer for operation in a vertical position.

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Products of United States Plywood

Gus Tames a Tough



Suddenly gas surged up and out of the filler neck, splattering Stan before he could shut it off.

Bird



By Martin Bunn

BUCKING and snorting, a Thunderbird rolled up the apron of the Model Garage, stalled, and slid back a trifle. Stan Hicks, Gus's assistant, hurried up to it.

"Oh, it's Mr. Kenquist," he said. "See you got another car."

The lean, lantern-jawed driver angled himself out past the windshield corner. "Need a new fuel pump quick. Got one?"

"Yessir. Are you sure it's pump trouble, though? I could check—"

"No time. I know what I want."

Stan looked appealingly at Gus, who had come out to read the pump registers.

"Morning, Mr. Kenquist," said Gus. "Does sound as if gas isn't getting through, but why not let us make sure before you pay for a new pump?"

"Give you five minutes," agreed Kenquist grudgingly. "No more."

Stan disconnected the pump line at the carburetor, held a can under it, and briefly cranked over the engine. A scant trickle of gas came out.

"Sure isn't pumping," he said. "Could be a plugged gas line."

Kenquist snorted. "Sooner you put in a fuel pump, sooner I can go."

Nevertheless Stan began to loosen the coupling between pump and tank. Suddenly a soft hiss sounded, becoming louder as the nut turned free. Then, abruptly, it stopped. Not a drop of gas appeared at the open coupling. Thoughtfully Stan retightened it.

"Well, what now?" asked Kenquist.

"Would you try your engine again?"

Black eyebrows scowling, Kenquist got in the car and turned the starter on briefly—without result.

"Told you I need a new pump!"

"Try a bit longer," urged Stan.

Angrily, Kenquist resumed cranking. Suddenly the engine fired up. It ran smoothly, but Kenquist got out no more pleased than before.

"It ran this morning. It runs now. That's no proof it will keep going."

"Don't suppose it will," returned Stan. "Let's see." He held the throttle rod at a fast run. The engine first took it well, then began to run rough.

"There!" cried Kenquist. "If that doesn't prove I need a new fuel pump, what does it prove?"

"Maybe that you need a gas cap," remarked Stan. "Did you change it?"

"It fell off on a trip," said Kenquist, following Stan to the back of the car. "Of course I got a new one."

Quietly Stan began to twist off the tank cap. As it came free, there was a whoosh of inrushing air.

"They sold you an unvented cap," explained Stan. "One for a car that has a separate vent tube. This cap has no hole to let air in as gas is pumped out. When the vacuum inside is the same as your fuel pump's pull, you get no gas."

"What! It's acted up several times, but the engine always started again."

"Sure. Air slowly leaks in. You drive a while, then the vacuum builds up. When I disconnected the tank line up front, it drew in air. Then the pump could deliver gas again."

"Hmmp. Got the right cap?" asked Kenquist. "I'll demand a refund on this one."

Grinning a bit smugly, Stan returned to the shop as Kenquist drove off.

"Isn't he the one who wouldn't change his engine oil?" asked Gus.

"Yeah. He swapped cars but not his positions. Soum as ever. All set to buy a fuel pump, but not a kind word when I fix him up for the price of a gas cap."

"I heard it all," Gus admitted. "Good job. You didn't even waste time as I would have, doing the one thing that wasn't necessary."

"What's that you'd have done?"

"Checked the gas gauge first," answered

Gus with a grin. "To make sure there was gas to pump."

DARKNESS lay on the suburban countryside as Gus drove back from a road call late that afternoon. Rounding a curve, he came on a pair of tail lights stopped ahead. Beside them a tall man waved an urgent signal.

Coming to a halt, Gus recognized both the sports sedan and its gaunt owner. "Trouble again, Mr. Kenquist?"

"Told your young smart aleck I needed a new fuel pump," snapped the black-browed man. "It used to start up again in a while after it quit. Now it won't even do that."

"Glad I happened along," said Gus, peering at the dash. "Got plenty of gas, I see. Is this gauge reliable?"

"Absolutely. Besides, I filled up just this morning. Haven't gone far enough to burn a tankful."

"Just let me get a trouble light and we'll see what can be done."

"No you don't," snapped Kenquist. "Got a dinner engagement—business dinner. No time to fool around. You tow me back, keep the car overnight. See you in the morning."

"If that's how you want it," agreed Gus. "But I might be able to fix it right here—save you a tow charge."

Lantern jaw set, Kenquist shook his head. Gus backed the wrecker into position for the tow, and hauled the Thunderbird in. But neither he nor Stan got around to checking it then.

"PLENTY of gas on the gauge," Stan reported the next morning. "But none pumps through. Sure is no air block now. Nothing's plugged, either. I put air on the tank line, and could hear it whistle way back in the tank."

Where'd it come from?



HANDAXE: The oldest known tool in the world is the handaxe—the first standardized tool man made to perform work. It was used for hammering, digging, boring, breaking, and chipping.

Early specimens were probably made from rock slabs of flint, quartz, sandstone, or lava, using a bone or naturally shaped rock as a hammer. Handaxes haven't been found on the sites of man's earliest ancestors, but specimens found in later deposits throughout Africa, India, and China suggest well-established toolmaking by Pleistocene times: 300-400,000 years ago.

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fire-ring spark plugs
They must be the best!

"That's interesting," said Gus. "Because it ought to gurgle."

Stan looked at him, then burst into a laugh. "Oh, no! You mean the gauge is stuck and old beetle-brows simply ran out of gas?"

"That's not possible," said a frigid voice. Morning sunlight threw Kenquist's long shadow on the shop floor. "I filled the tank and drove only 150 miles."

"Suppose we put in one gallon and try the engine?" suggested Gus.

"Go ahead!" grumbled Kenquist. "Then install a new fuel pump."

From a can Stan poured one gallon into the tank. After moderate cranking,

gurgled. You'd better put it on the lift."

LIPS pursed, Kenquist stood by as Stan raised the car. Gus walked under it with a light. The tank showed no trace of leakage. But one side of it was caved in.

Stan whistled. "Looks like one of those sideshow boys who can suck in his stomach."

Cautiously Kenquist ducked under the lift. "What is it?"

Gus flashed the light on the collapsed tank. "With that unvented cap, the fuel pump created quite a vacuum in the tank. That let outside air pressure shove in this wall, and that's why the tank holds only 11 gallons."

"Not enough. Going to be a nuisance on long trips," said Kenquist.

"Maybe we can pull it out," mused Gus.

"Shall I hook an air hose to it, Boss?" asked Stan.

"There's a tool might do it faster," mused Gus. "Go get it, Stan. It's in the store room."

Stan was momentarily puzzled. Then his face lit up. "Oh, that one!"

Kenquist retreated into frowning silence. In a moment Stan was back with a common "plumber's helper"—a big rubber suction cup on a stick.

Wiping the tank clean, Gus applied a smear of grease around the suction cup, seated it firmly in the center of the tank, and gave it a sharp pull. With a loud click the dent snapped out.

"There's your 20 gallons back," said Gus, wiping the grease off. "That dent is probably what jammed your tank float. I think your gas gauge will tell the truth from now on."

Kenquist's lips quivered in a ghost of a smile. "Hard thing to get at—the truth—isn't it, Mr. Wilson?" he grunted. "Would have been easier for you to sell me a new fuel pump . . . But it wouldn't have solved my problem."

"Not only that," Gus grinned. "But now I've got a full-size tank to fill up when you stop in for gas. I'd rather sell 20 gallons than 10, any day."



the engine took hold with a deep roar.

"Doesn't seem like a bad fuel pump," remarked Gus. "It's your gas gauge."

"Fill the tank," ordered the lantern-jawed man. "It holds 20 gallons, but you won't get in 10."

Obediently Stan ran the car to a pump and started fuel flowing in. Kenquist watched the pump meter. Ten gallons poured in. With an inward grin Stan opened the hose valve farther.

Suddenly gas surged up and out of the filler neck, splattering him before he could shut it off. The tank was brim-full. Without a word Kenquist returned to the shop.

"She took 10½ gallons, Boss," reported Stan a minute later. "Full up."

Gus frowned. "But that model does have a 20-gallon tank—and the air didn't

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ACTIVERTER

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Now—from the laboratories of ESB—comes a major breakthrough in "packaged power"! Using advanced solid-state electronic components, ESB engineers have developed a revolutionary, transistorized inverter-charger, the ESB ACTIVERTER. This amazing new product means that you can now have the convenience and the utility that 110 Volt AC current can bring, and you can have it wherever you can take a 12 Volt storage battery! Just connect the ESB ACTIVERTER to a battery and you can plug in portable electric power tools, an electric blanket, electric lights, even a television set! A flick of a switch and the ESB ACTIVERTER becomes a battery charger.

The miracle of transistors makes "house power" truly portable!

ESB ACTIVERTERS are the result of a totally new concept in electronic design. They are fully transistorized to reduce weight, increase reliability, and to provide the ruggedness that a portable power package must have. There are no moving parts or vibrators—ESB ACTIVERTERS are quiet in their operation!

The compactness of the ESB ACTIVERTER design makes it possible to have a 12 Volt storage battery, an inverter, and a battery charger all in one self-contained and truly portable package. One PAK-O-POWER model provides a source of 110 Volt alternating current, with an output rating of 500 Watts, in a package the size of a portable picnic cooler!



Dependable current for hundreds of applications!

Where in this wide world would you like to have the convenience and versatility of "plug in" 110 Volt AC current? With the ESB ACTIVERTER you can have it instantly, anywhere, for many hours! On camping trips you can have the comfort and pleasures of television, radio, electric lighting. On and off the highway you can power general service tools and impact wrenches, or use the ESB ACTIVERTER for car starting and emergency lighting. Boat owners can have 110 Volt AC available afloat or at dockside. We have compiled a list of several hundred ESB ACTIVERTER applications, yet many uses for this revolutionary new product have not even been thought of. They will come from people like you who want and need portable power for specific and perhaps unique purposes!

Battery charger is built in!

In designing this remarkable new product we've considered every feature that would increase the versatility and usefulness of packaged power for you. And that includes a built-in battery charger, electronically designed, without increasing ESB ACTIVERTER weight and size. A simple switch lets you convert alternating current from a household outlet into direct current for either fast or slow charging of 6 and 12 Volt batteries.

Four different models provide from 150 to 500 Watts!

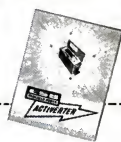
MODEL I-152 INVERTER—Inverter only, operates from direct connection to 12 Volt battery or through cigarette lighter socket of cars with 12 Volt systems. Output ratings: Intermittent Use—150 Watts, 1.5 Amps. AC... Continuous Use—125 Watts, 1.2 Amps. AC. Shipping Weight: 8 lbs.

MODEL IC-252 ACTIVERTER—Inverter-Charger operates from direct connection to 12 Volt battery. Output ratings: Intermittent Use—250 Watts, 2.3 Amps. AC... Continuous Use—200 Watts, 1.8 Amps. AC. Shipping Weight: 15 lbs.

MODEL IC-202P PAK-O-POWER—Inverter-Charger with compartment for 12 Volt battery. Completely self-contained unit. Output ratings: Intermittent Use—250 Watts, 2.3 Amps. AC... Continuous Use—200 Watts, 1.8 Amps. AC. Shipping Weight less battery: 22 lbs.

MODEL IC-506S PAK-O-POWER—The Multi-Service Inverter-Charger-Car Start unit, with large 12 Volt battery compartment and Car Start leads. Completely self-contained with built-in fast and slow charger—Charging rate: 60 Amps. for 6 Volt, and 40 Amps. for 12 Volt batteries. Output ratings: Intermittent Use—500 Watts, 4.0 Amps. AC... Continuous Use—300 Watts, 2.5 Amps. AC. Shipping Weight less battery: 55 lbs.

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Please send me ESB ACTIVERTER information without obligation.

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The Electric Storage Battery Co. • Automotive Division • Cleveland 1, Ohio

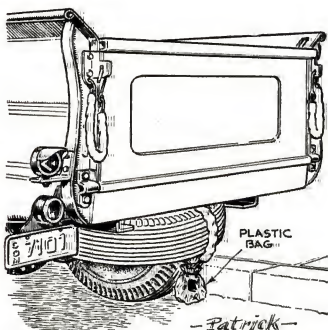
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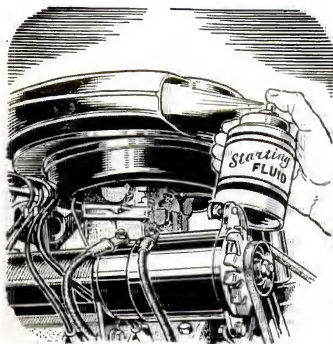
Hints from the Model Garage



If the starter fails even though lights and horn work, feel the battery clamps. A warm clamp indicates a poor connection and voltage drop. Try tapping the clamps down tightly on the battery posts, or remove and clean them, then tighten.



The padlock on the spare tire beneath a truck can be protected from rust, mud, and dirt by slipping a plastic bag over it. Squirt a few drops of light oil into the bag, and fasten it over the lock with a gardener's twist-on plant tie.



If your car is balky and hard to start on cold mornings, try spraying starting fluid into the air intake while the car is cranked. The fluid, available in pressurized cans at auto-supply stores, will fire at once and save draining the battery.



To maintain side visibility when driving in heavy snow, run the front door windows up and down occasionally. The felt strip in the door frames will clear snow from the glass, permitting you to see through both windows at crossroads.

CONTINUED



Nomad 6-Passenger 4-Door Station Wagon:
hard-working utility with a glamorous flair.

*Here!
A new measure of
your money's worth...*

NEW 1961 CHEVROLET!

Here's clean-as-a-whistle style that'll never cramp yours. No needless bulk or ornamentation on this '61 Chevy. And inside you'll find a full measure of roominess and comfort. Getting in and out is a breeze, thanks to doors that are up to 6 inches wider. And sitting in this new Chevy is pure solid comfort because those new seats are the closest thing you could want to easy-chair height and accommodation. There's also a new kind of deep-well trunk (you can stack baggage 15% higher) for hauling odd-ball objects you used to have to leave home. These are improvements you can see, feel and sit upon—improvements that make Chevy America's Number One new-car investment.



Bel Air 4-Door Sedan: with contemporary-contoured rear deck and canopied roof line.

Now... big car comfort at small car prices

NEW '61 CHEVY BISCAYNE 6 *the lowest priced full-sized Chevrolet!*

Here's the Chevrolet that gives you everything that makes a big car worthwhile, at a price you'd expect to pay for shaved-down cars that give you a lot less. These new

Biscaynes combine all of Chevy's 1961 improvements with the traditional Chevy pluses of solid Body by Fisher, tried and true V8 or six-cylinder dependability, and smooth, sure Full Coil ride. Try a '61 Chevy Biscayne, your budget will love you for it!



Biscayne 4-Door Sedan.

More Hints from the Model Garage



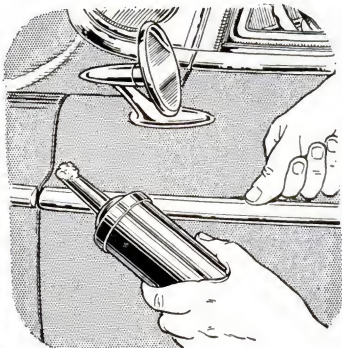
Tire chains won't tangle if you take an extra moment to lock the free ends together before storing them. When you need them, they'll be ready to install without delay, whether you keep them neatly in a can or loose in the trunk.



You'll save your back and the deck of your station wagon by placing heavy loads on a loose piece of carpeting. This makes it easier to push the object into the wagon, and you have only to yank on the carpeting to pull it out when unloading.



You can work in the dark with both hands if you fasten a flashlight to your forearm. Use masking tape or heavy rubber bands to hold the light in place. Its beam will always be focused on the work area as you move your hands about.



Rust under molding strips can be prevented by pressing calking compound between the *top* edge of each strip and the body of the car to keep slush and water from running in behind. Leave the bottom edge of the trim open for ventilation.



"bargain"
batteries
BAH!

from now on it's a Delco DC-12 for me!

You can try to get by with a "bargain" battery—but a couple of dollars more for a Delco DC-12 Dry Charge can save you time, money and trouble!

What does it cost you to be two hours late for work? Most of us can't afford it, and it's especially annoying when caused by a bad battery. A dependable Delco Dry Charge Battery starts you off on time day after day, in all kinds of weather . . . yet it costs little more than so-called "bargain" batteries.

**WHY YOU CAN BE SURE DELCO DC
IS 100% FRESH**

Delco Dry Charge Batteries stay bone dry until sold . . . can't lose any "zing" on the shelf. Delco DC comes to full, 100% fresh power only when you actually see the dealer add the activator fluid that makes it ready for work . . . thus you can be sure you're getting all the power you pay for!

**YOUR DELCO BATTERY DEALER
IS A LOCAL BUSINESSMAN**

He appreciates your business, and automotive service is his specialty, not a sideline. He knows your car and your driving habits, and can specify the Delco DC battery that suits you best. He is conveniently located a few minutes from home, wants your continuing

gasoline, oil and service business . . . and wants to be sure that you're satisfied and will come back regularly.

**WHY JUST TRY TO GET BY . . .
BE SURE WITH DELCO DC-12!**

If time or money means little to you, you can afford a "bargain" battery. But if you're in the same boat with most folks, you need the 100% fresh, dependable power that makes Delco America's No. 1 Battery . . . "Designer's Choice" for most new cars, and "Driver's Choice" for replacement, too . . . proved so in surveys year after year. When it's time to replace, ask your dealer for Delco DC-12.



DELCO DC-12 . . . Best to START with . . . Best to STAY with

Another reliable
General Motors product,
distributed nationally through



SEE TWO NEW TV SHOWS FOR DELCO—"Stagecoach West" and "The Islanders" on ABC-TV.

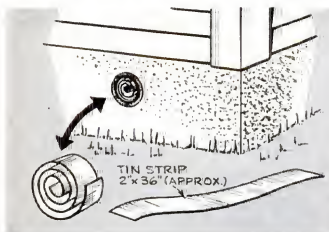
Short Cuts and Tips

FROM PS READERS

Canvas Sling for Carrying Logs

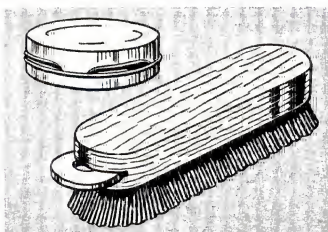
OUR clothes got smudged and snagged every time we toted a load of fireplace logs from the woodpile. So I made this sturdy sling from a canvas boot cover from my old convertible. Any strong fabric, such as denim, would do. Stitch loops in each end to take broomstick handles, and cut out half circles for a finger grip. The sling rolls up for storage.—*Robert Micala, Freehold, N.J.*

►►► FLOOR flanges screwed to porch-stair treads offer poor support for a pipe railing. Instead, anchor each post by inserting its threaded end through a snug-fitting hole drilled in the tread, turning it into a flange mounted upside down on the underside.—*M. Robert Beasley, Detroit.*



Rodentproof Tile Vent

KEEP rodents from entering the ventilating tiles in a foundation by inserting a loose coil of tin or galvanized iron. The coil permits free air circulation and is easier to install than screening.—*G. E. Hendrickson, Argyle, Wis.*



Pry for Shoe-Polish Lid

DON'T you ever settle down to polish your shoes only to find there wasn't anything in reach to open the can with? Never again, if you cement a large washer into a saw kerf at one end of the shoe brush.—*A. S. Henney, San Diego, Calif.*

The EXTRA WEIGHT in this Atlas 10" Saw Means GREATER ACCURACY in the Work You Do



Why settle for less?
You can own an
Atlas for only
\$139.75! Write for
details today.

Because it has more beef—because it's heavier and huskier throughout—the Atlas gives you far greater accuracy in every job you do. Compare these Atlas features with those of any other 10" saw:

- Massive grey-iron cradle, saw arm, and trunnions. Atlas has the heaviest, most rigid mechanism of any 10" saw. Saw alone weighs 165 lbs!
- Precision-ground, solid steel arbor— $\frac{3}{4}$ " diameter at the big, lubricated-for-life ball bearings.
- Double locking lift-off fence—cast aluminum for lasting accuracy.
- Big cast aluminum mitre gauge—keyed to table for greater cut-off capacity.
- 6" diameter cast iron handwheels.
- Dual V-belt drive—for full power transmission.
- Big table capacity—20" x 27 $\frac{1}{2}$ ", or 59 $\frac{1}{2}$ " x 27 $\frac{1}{2}$ " with two extensions.
- Removable motor mount for easy portability.



354

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MOST EXCITING
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Short Cuts and Tips

FROM PS READERS

This Dodge Saved the Day

JUNIOR was standing in the corner and my wife was already looking up the plumber's phone number when I got this idea for retrieving a plastic tumbler that had lodged in the elbow bend of our toilet.

I siphoned off the water in the bowl and placed a small mirror on the bottom. With a flashlight beam reflected through the mirror, I was able to see up into the elbow. I pushed a heated coat-hanger wire with a hooked end against the tumbler. The hook

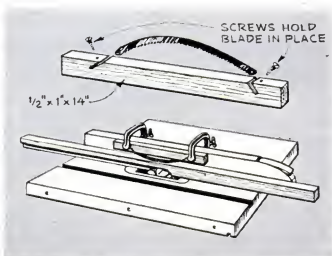


melted through the plastic and, when it cooled, caught. I was able to pull the tumbler out of the pipe easily.—*Ronald Thiel, Dayton, Ohio.*



Homemade Picture Hangers

SCRAPS of thin leather can be cut into various neat shapes for hanging small pictures and plaques. Cement the flaring lower section of the tab to the back of the item. Punch a hole in the protruding flap and crimp a brass eyelet through it to take a nail or thumbtack.—*Arthur R. Tanner, Poughkeepsie, N.Y.*



Hacksaw Blade Hold-Down

SHAPING moldings or ripping narrow strips on the bench saw is awkward and dangerous without a spring hold-down. Make one by bowing an old hacksaw blade between angled saw kerfs in a block of wood. Clamp the block to the saw fence and adjust it for desired pressure.—*G. E. Hendrickson, Argyle, Wis.*

How That Cut Was Made with the Circular Saw

[Problem on page 174]

TOM proved his point. He simply turned the cabinet upside down; whereupon the uncut left end of the shelf became the right, and the portable power saw could cut close to the wall.

GET BOTH HOME PROJECT BOOKS—FREE!



1. **"101 HOME IDEAS"**—24 pages, many in full color, feature home-building, remodeling and decorating ideas using wood paneling. For living rooms, dens, playrooms, dining and kitchen areas, storage and utility rooms, bathrooms, bedrooms . . . traditional and contemporary. Tips on choosing grades, species, patterns to fit your way of living. Section on built-ins, finishes and effects.



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H-70B	2-1/2"	10"	21-1/4"	1-1/2"	1-1/2"	10.88
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H-70E	2-1/2"	30"	40-1/2"	1-1/2"	1-1/2"	24.88
H-70F	2-1/2"	48-1/2"	64-3/8"	2"	2"	29.88
H-70G	3-1/2"	8"	19"	2"	2"	17.88
H-70H	3-1/2"	10-1/4"	21-1/4"	2"	2"	19.88
H-70J	3-1/2"	22-15/16"	34-1/4"	2"	2"	29.88
H-70K	3-1/2"	30"	41"	2"	1-3/4"	34.88
H-70L	3-1/2"	43-1/2"	55-1/8"	2"	1-3/4"	44.88
H-70M	3-1/2"	47"	64-1/2"	2"	2"	49.88
H-70N	4"	22-1/4"	34-3/8"	2"	2"	36.88
H-70P	5"	43"	55-1/8"	2"	2-1/4"	79.88

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SHOVEL or
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Shovel blade folds for pick or shovel. Has 20" handle. Pickmattok has 12" head of steel.

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Surplus 1-1/2 HP, 24 V, DC motor & pump. Will deliver 3-1/2 gallons per minute.

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ELBOW SCOPE
ONLY 988**

Field 325 ft. or 1000 yards, 2" objective lens and Kellner eyepiece.

**ASTRO
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Gives true heading, determines bearing and compass errors. Originally cost Gov't approximately \$87.50

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GOOGLES**

Has interchangeable, precision gnd. lenses. Choice of clear, green or amber lenses. Rubber covered metal frames. . . . \$2.92

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The Wellsaw 400 is an all around cutting tool that will do just about any job you can do with a hand saw. It handles much like a hand saw, too. You just apply firm guiding pressure, the husky 7 amp. motor does the work delivering 8,000 $1\frac{1}{8}$ " cutting strokes per minute. There's no kick, no pull, no whip.

8" BLADE is all usable, supported and guided its full length.

SAFE—blade stops in less than $1\frac{1}{2}$ seconds after trigger is released.

ECONOMICAL "THROW-AWAY" BLADES, fine, medium and coarse, are changed quickly and easily.

QUALITY BUILT to heavy duty industrial standards.

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☐ Send descriptive bulletin on Wellsaw 400
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Name

Street

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PSM-161

Can We Stamp Out Mileage-Rigging?

[Continued from page 62]

A few days later he saw the same wagon on the street. The man at the wheel was the customer he had lost.

"Look," exclaimed the happy motorist, "only 28,000 miles on this car."

Instead of \$1,500, the motorist had forked over \$1,850. The dealer didn't tell him he had been suckered.

"A man buying a used car *wants* to see a low mileage," another dealer told me. "Even if the car has gone 45,000 miles, he's not happy unless the odometer shows, say, 12,666 miles. It's psychological tomfoolery."

"Why," he went on, "even after we've turned back the odometer once, a customer asks us to turn it back even more. He wants to fool himself, or make his wife think he's sharper than he is, or he's afraid of what his friends will say."

On record in New York State's Consumer Frauds Bureau is the case of an Oldsmobile traded in after more than 20,000 miles. The car was a creampuff. It looked good. A dealer made it glitter, turned back the odometer to 2.8 miles, and sold it to an unsuspecting buyer as a new car.

That sale backfired, as I shall tell you in a moment.

Owners do it, too. Many private owners, ready to trade in the old jalopy, have their odometers set back, or do it themselves. Sometimes they strain the credulity of old, practiced hands in the auto business.

"My speedometer suddenly jumped ahead 10,000 miles," they'll report. "Can you turn it back to what it should be?"

It's common to misrepresent new-car mileage. Dealers told me that many cars showing 1 to 20 miles on the odometer actually have been driven from 50 to as many as 6,000 miles. The dealers simply leave the speedometer cables disconnected. One man commutes regularly between showrooms in two states in his new cars, putting on as much as 1,500 miles before delivering them, as new, to purchasers.

Disconnecting the cable. One reason why odometer-doctoring is so widespread is that it's so simple. Dealers told me that an increasing number of new-car buyers, expecting to turn in their cars after a year, chisel the mileage reading by dis-

Can We Stamp Out Mileage-Rigging?
connecting the cable after 10,000 to 12,000 miles.

Some "doctors" disconnect the cable from the car's drive shaft and hook it up to a power drill. A workshop motor turning clockwise at 3,500 r.p.m. will roll an odometer back at the rate of 210 miles an hour.

It may be quicker to turn the reading ahead, letting it go up to 99,999.9 and then go around again. Some garages have small, geared turn-back motors that can switch odometers either way. It damages some odometers to run them backward against the delicate gears.

Other odometers can't be rolled back at all, only forward. The Jaguar's is one.

Because doctoring with a drill is slow work, some mechanics unscrew the speedometer assembly from the dash panel, and remove the odometer drum. The drum has six disks, mounted on a shaft like doughnuts on a stick, that carry the numbers. On some instruments the tap of a hammer on the shaft loosens the disks so they can be twirled freely by hand. A reading of 80,000 can be set back to 40,000 merely by spinning the "8" to "4".

Other instruments turn easily without being loosened, but on these it's necessary to rotate all the disks.

The whole job can be done in a half-hour on some cars. On standard-size Fords, Plymouths, and Chevies it takes an hour or so. A Buick odometer is stubborn, and the cost runs from \$7.50 to \$10. Fixing Cadillacs and Imperials, with their fancy lighting and intricate panel wiring, may cost \$20.

They get you both ways. There's a gadget for dealers that actually reverses the registering gears of the cable. A customer may drive a demonstrator 100 miles. When the car is returned, a salesman merely flips a hidden lever and for the next day or two the odometer runs backward, wiping off the 100 miles.

Incredibly, only Wisconsin and New Jersey make it a legal offense to turn back an odometer in order to sell a car. And despite the great stress on safety and safe speeds today, only Wisconsin has a law requiring that speedometers be kept in good repair. In many states you don't even have to have a speedometer in your car.



with a *Weller*® Dual Heat **SOLDERING GUN KIT**

Only Weller has Dual Heat! 2 trigger positions give low 90-watt and high 125-watt heat as your job requires. Tip heats instantly, has superior heat transfer and long reach. Spotlight eliminates shadows. Result... soldering is simple, sure and fast. Kit includes cleaning brush, soldering aid and solder.

Model 8200K **\$795**

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Can We Stamp Out Mileage-Rigging?

But the laws on fraud are universal. You don't *have* to be cheated on mileage in buying a car.

The buyer of that "new" Oldsmobile mentioned above—a woman—crashed into another car a few days later. Her brakes had failed. A mechanic diagnosed the trouble—and discovered that the car was far from new. Quietly investigating, the woman turned up the prior owner. Then she slapped a damage suit on the dealer, charging fraud. He settled for \$1,000.

But the lady wasn't through yet. She complained to the state motor-vehicle bureau. The dealer's license was lifted. He discovered, too late, that his customer just happened to be an exceptionally smart—and properly indignant—lawyer.

Another dealer, underestimating his customer, sold a "demonstrator" sedan with 2,600 miles on the odometer. The new owner, curiously probing around, discovered that the car actually had been driven 18,000. He, too, sued. His award: \$1,200. The customer, you see, had been an automobile dealer himself once.

"There ought to be a law." Many dealers—possibly most of them—would welcome a law that would scotch odometer-doctoring. They doctor odometers for competitive reasons. If one dealer does it, the dealer on the next block must do it too if he is going to sell his stock of used cars.

In New York State's Consumer Fraud Bureau is a young assistant attorney general named Robert Loevin. He has discussed the problem with many dealers. Here's his solution:

"Since safety and honest trading are both involved, each state should require by law that every car have a pedigree. Require that mileage be recorded, as you are forced to record the engine number, whenever a car is sold. But, even more important, require that it be recorded each year in the owner's application for a license tag."

Loevin would put teeth in the law by making it an offense to falsify mileage, and by requiring the mileage to be stated on every bill of sale. Violators could be prosecuted for fraud.

With such a continuing pedigree on every car, our disgraceful mileage-chiseling racket would be stopped. So would a lot of needless accidents.

Answers to PS Puzzlers on 16 and 18

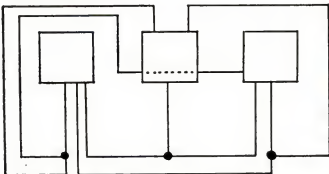
Dancing partners. Number the clues:

1. Betty was dancing with Ed.
2. Alice with Carol's husband.
3. Dorothy with Alice's husband.
4. Frank with George's wife.
5. George with Ed's wife.

Let's find out who Ed's wife is. She's not Betty (by 1 and 5). She's not Alice (by 1 and 3). She's not Carol (by 1 and 2). So she must be Dorothy. Immediately we know that George is dancing with Dorothy (by 5) and that he is (by 3) Alice's husband. Then (by 4) we know Frank is dancing with Alice which (by 2) makes Frank Carol's husband. Now we've got them all paired off but one couple: Betty and Harry (the only ones left).

P. S. Harry and Carol aren't dancing.

Live wires. The ninth line must be fed through one of the houses. This is one way it could be done:



Bargain-priced oil. The last buyer took half of what was left plus half a quart, and that finished the lot. The only way that could happen (given that the dealer never broke a quart) would be if the last buyer bought the one last quart. Add the second buyer's half quart to that and double it to get the amount he was faced with: three quarts. (He bought exactly two.) Now add the second buyer's half quart to three, double that to get the amount the first buyer was faced with: seven quarts.

The algebraic solution is straightforward, too:

Let x = the total number of quarts. Then buyer A buys $\frac{1}{2}x + \frac{1}{2}$ and leaves:

$$x - (\frac{1}{2}x + \frac{1}{2}) = \frac{1}{2}x - \frac{1}{2}$$

Buyer B buys $\frac{1}{4}x - \frac{1}{4} + \frac{1}{2} = \frac{1}{4}x + \frac{1}{4}$ and leaves:

$$\frac{1}{2}x - \frac{1}{2} - (\frac{1}{4}x + \frac{1}{4}) = \frac{1}{4}x - \frac{3}{4}$$

Buyer C buys $\frac{1}{8}x - \frac{3}{8} + \frac{1}{2} = \frac{1}{8}x + \frac{1}{8}$. And leaves nothing. So:

$$x = (\frac{1}{2}x + \frac{1}{2}) + (\frac{1}{4}x + \frac{1}{4}) + (\frac{1}{8}x + \frac{1}{8})$$

$$x = \frac{7}{8}x + \frac{7}{8}$$

$$x = 7$$

"Think fast." 1) The same number, of course. (Ships float, you know.)

2) It's as easy as one-two-three.

3) Five boys. (Working together they pack one box a minute—and thus 50 boxes in 50 minutes.)

217

"CAN DO" FROM START TO FINISH



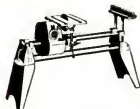
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Air-Bubble Sun Port for \$50

[Continued from page 142]

The damper can also be manually adjusted to control the temperature inside the dome by speeding up or slowing down the air flow. With the 12" blower on and the vent fully open, the rush of air feels like a brisk ocean breeze.

You enter the dome through a double-door air lock that prevents air from escaping. The air lock is only necessary, says Muehlmann, to avoid sudden changes in temperature if you're working with delicate flowers. For other purposes, an ordinary single door works fine without collapsing the dome.

Muehlmann has added a center pole to keep the dome from collapsing if the power should fail, but he points out that this is necessary only to protect his flowers. For a sun room or play area, it does no harm to let the plastic collapse temporarily.

How the dome is made. Twelve identical sections shaped like pie wedges give the plastic its hemispherical shape. For a larger structure, the dome can be split down the middle and any number of straight-sided sections inserted between the ends, producing a Quonset-hut shape.

Muehlmann used four-mil polyvinyl film and found it perfectly adequate. Larger ready-made air houses usually use six-mil film, which is a bit heavier and more durable. Both types are sold in rolls up to 6' wide under such names as Calvinol, Marvinol, Eskay-lite, and Amerex. They're available at building-supply houses and lumberyards.

Polyethylene film can be used in place of vinyl. It is less expensive, but it's also less durable. Most polyethylene air houses are good for only one or two years, while the vinyl will last three to five years. At about three cents a square foot for the vinyl, it can be replaced very inexpensively even if you have to do it every three years. For longest life, it's best to use your air house only in the fall and winter, and store it during the summer.

Laying out the sections. The pie-wedge sections are cut by first laying out a center line and marking off points on either side of the line at 1' intervals, as shown in the drawing. A quick and easy trick that Muehlmann used was to

Air-Bubble Sun Port for \$50

lay out the pattern on the cellar floor—chalk or crayon is good here. Then he placed each sheet of plastic over it and cut along the outlines with scissors.

Muehlmann used 200' of plastic 5' wide. After the sections were cut, he simply stitched the edges together on his wife's sewing machine. Ordinary cotton thread can be used, but nylon is stronger and more weather-resistant. To reinforce the stitches, Muehlmann pressed 1"-wide self-adhering vinyl tape over the seams—although he found later that the tape wasn't necessary.

The base for the dome is laid out by marking off a circle around a stake at a radius of 8' 10 $\frac{3}{4}$ ". The spot you pick should be as level as possible. Twelve two-by-sixes, each 4' 7 $\frac{1}{4}$ " long, are then staked to the ground on edge around the circle to form a rim.

The plastic dome is stapled to the top of the rim boards to anchor it down. Strips of vinyl tape are then placed over the staples and half-round molding is nailed on top, as shown in the sketch. This is important, to keep the plastic from tearing loose at the rim. To make a tight air seal, an additional strip of plastic 2' wide is stapled to the rim boards and carried down below the soil about 3" deep around the inside of the dome.

Make it movable. For a completely portable dome, you need only weight down the edges of the plastic with a rim of sandbags, eliminating the foundation.

Openings for the blower intake, vent, and doorway are all made by stapling the plastic around wood frames and covering the edges with molding strips. The air lock consists of two old screen-door frames spaced apart by furring strips and covered with plastic.

An even simpler entranceway can be made by providing merely a slit in the plastic that you open like a tent flap, as is done on many ready-made air houses. The slit is kept airtight either by two lips that overlap several inches or by a slide fastener.

Muehlmann added a trim little hedge around his dome to hide the foundation and a bed of bluestone inside to make an inexpensive floor. He's so pleased with his air bubble that he's planning an even bigger one for this spring. It will be 50 feet long.



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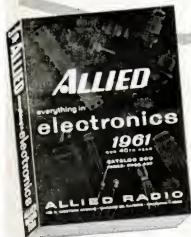


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Shaping the Savannah Superstructure

(Continued from page 154)

Simulate canvas boots by painting the boat tops buff.

King posts, booms, mast, flagstuffs. While you can make these of 1/8" dowelling, No. 4 plastic knitting needles are less likely to break. Notch cargo king-post parts for cemented lap joints, and complete each assembly before cementing it. Tackle blocks and running lights are cross sections sliced from dowels. Crow's-nests are bits of balsa. Form balls for mastheads and flagstaff tops by placing drops of cement on the ends.

Deck fittings. Cut the rectangular bases for the bitts from Bristol board. Cement them down and drill holes for snubbing posts cut from swab sticks. The anchors and winch assemblies are shown in drawings. Capstan winches at the stern are brass turnings. Use rattan splinters and wire for the radar antennas on the top deck, and a little piece of perforated metal from a radio-tube grid for the radar "basket" on the mast.

Shaping the rudder. One of the detail drawings shows the arrangement of parts. Scale up the profile plan to make templates for the rudder-blade sections. When you solder the collar to the bottom of the brass tube to hold the hinged assembly together, slip a temporary paper shim under the movable blade sections. That will insure a bit of vertical play for free hinge action.

To install the rudder, drill a 1/4" hole vertically through the center of the rudder-post nub in the fiber-glass casting. Also bore a 3/8"-diameter hole horizontally through the back of the hull's propeller-shaft housing.

Position the upper end of the rudder assembly in the 1/4" hole and fasten it there with a generous fillet of epoxy glue on each side of the fiber-glass. After the adhesive sets, solder the tiller to the top end of the rudder rod.

Propeller and shaft. The big Savannah has a five-bladed prop, but you'll find that a three-bladed job gives fine performance and is easier to form. Turn the hub from a 3/4" section of 5/8"-diameter brass stock through which you've drilled a 1/4" hole for the propeller shaft. Drill and tap a smaller hole through the side wall for a recessed setscrew. Fasten the hub to a short length of 1/4" rod, and

Shaping the Savannah Superstructure

chuck the rod in a lathe (or an electric drill) to round off one end.

Hacksaw three equally spaced slots deep enough into the hub to get a firm grip on a set of blades cut from $\frac{1}{16}$ " copper. Note that the cuts are made at a 25-degree angle to the back face of the hub. Cut and file the blades to shape (each is $\frac{7}{8}$ " long, $\frac{1}{16}$ " wide at the base, and terminates in a $\frac{5}{16}$ "-diameter half circle). Press the blades into the slots and sweat-solder them. File the solder to remove any lumps and form a slight fillet to fair the blades into the hub. Back out the setscrew to release the drill-rod "handle," and replace it with a $4\frac{1}{2}$ " length of $\frac{1}{4}$ " rod. This is the Savannah's propeller shaft.

Propeller-shaft bearing. A fine one can be made from a $\frac{3}{8}$ "-by-3" brass nipple that will set you back 5¢ at an electrical-supply store. Bore a hole through the side wall and sweat-solder an old oil cup into it. Push the tube through the $\frac{3}{8}$ " hole in the back of the hull casting from the inside, just far enough to thread a nut onto the projecting end. Anchor the other end with a hardboard block, epoxy-glued to the interior of the hull. Again, thread a nut onto the tube projection. Fasten both nuts permanently with fillers of epoxy glue.

Painting the hull. Cover the area that is to remain white with newspaper and masking tape. With the hull right-side up, use aerosol paint to spray on the bright red belt at water line. When the paint dries, cover the part that is to remain bright red with more tape, turn the hull upside down, and spray dark red paint on the exposed bottom area. Remove the masking. Cement the anchors in the hawsepipes.

Use dark red for all lettering. The ellipses of the atomic emblems are black, red, and green, working downward in order of size. For the staggered blue stripes on either side apply thin strips of adhesive-backed decorating tape.

Paint the propeller bronze. Remove the hub from the shaft, slip the shaft through the bearing from the hull interior, and fasten the propeller back on the end protruding from the propeller-shaft housing.

Next month, you'll be coupling the other end of the shaft to a steam-turbine power unit.

Skilled Machinists Prefer South Bend

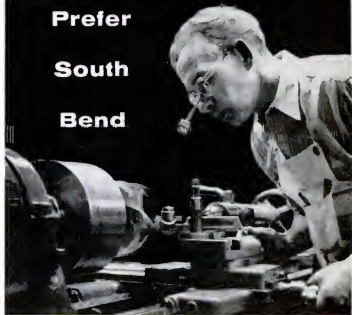


Photo from Learcal Division, Lear, Inc., Los Angeles

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a minute and zip through a two-by-four in 2½ seconds.

On big jobs, like framing a house or garage, this adds up fast. The 500 or so two-by-four cuts required to frame the walls of a typical six-room house take half a day by hand, less than half an hour with a power saw.

Driving nails. There's no substitute for a hammer to drive the 2,000 or more nails that go into a house frame. But it's good to be able to gauge about how long the job will take.

With a 16-ounce hammer, you can drive a 16-penny common nail flush in a two-by-four in four seconds. So—to drive 2,000—you can count on a good three hours of swatting.

Boring dowel holes. This is a job you shouldn't rush. But even using care, you can sink a ¾" hole 1½" deep in three seconds with an electric drill, as against seven seconds with a hand brace. Because the power drill is faster and less tiring, it generally does a cleaner, more accurate job than a brace.

In boring larger holes, as for BX cable, the electric drill will punch a ¾" hole through a wall stud in 6½ seconds—more than twice as fast as its pokier hand-powered cousin, which needs 14 seconds. This amounts to a saving of two hours on a typical one-story wiring job.

The time gap widens still more on sawing large holes, as for plumbing or to install a kitchen sink. With a hand brace and compass saw, you'll need three minutes—and a liberal supply of elbow grease—to bore a starting hole and cut a sub-floor for a 4" soil pipe. By using an electric saber saw that makes its own starting hole and cuts 4' a minute, you can do the whole job in 35 seconds.

To saw a sink opening in a kitchen counter top takes about an hour with hand tools, only 12 minutes with the saber saw. If you've been wondering whether to nick the budget for such a tool, this is a persuasive argument in its favor.

Sanding and planing. For rough sanding, a flexible disk or belt sander will far outstrip either an orbital sander or a hand sanding block. They'll smooth away a ¼" saw cut in end-grain pine in 15 seconds, compared to a minute for

the orbital sander and 1½ minutes by hand. But for fine finishing a hand block or orbital sander will give you a smoother job than a disk or belt sander.

If you've been tempted by a power-plane attachment for an electric drill, here's another surprising test. With the drill attachment, you can shave ¼" from a 2' length of 1" pine in 15 seconds. With a hand block plane, the same job takes about 25 seconds—not as long as you might expect. For occasional work, obvi-
.....

NEXT MONTH: Do you heat your house with steam? February PS presents a roundup of money-saving and heat-saving tips on how to get the best out of a heating plant.
.....

ously, a hand plane is perfectly adequate. For big jobs, a power attachment could be an important aid.

Are power tools always faster? No. On short, on-the-spot jobs you may save time by *not* using power tools. You can trim the excess off an oversize door, for example, in about the same time it takes to string up an extension cord for a power saw. The same applies to drilling the holes for the strike plate.

Choosing the best tool for the job depends to some extent on your own skills. You can time yourself easily to see how you compare with the figures given here or to find out how you do with other tools. All you need is a helper and a clock with a sweep-second hand.

In clocking brief, repetitive toolwork, such as driving nails or screws, base your findings on an average of at least five successive operations. Simulate actual working conditions as much as possible since the normal pauses between operations must be included to give you a realistic total.

Whenever you do a major job, such as putting up a wall or shingling a roof, make a note of the total time required as well as the individual operations. A record of such times will help you estimate the size of future jobs. Where you're working with hand tools, it's wise to clock yourself over an extended period since initial speed falls off rapidly with fatigue.

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Fixing I. F. Amplifier Faults

[Continued from page 149]

on the floor. The youngster was quietly loading two tube shields into a toy truck. Pete grinned as he waved me out.

The Case of the Unmarked Sockets

TO MY dismay, an ophthalmologist in the family recently informed me that I needed glasses. It was a hard blow.

My relationship to the doctor is a bit unusual. He's my uncle, but he's 90 days younger than I. There's a good-natured running feud between us.

One day Bart called me to look at the TV in his waiting room. He usually fixes it himself if it only needs new tubes. When he's successful, he's unbearably smug about it. This time he had goofed.

In the I.F. strip there are many tuned circuits that are critically aligned at the factory with the original tubes in operation. Since there are small differences between individual tubes—even of the same type—a different tube in a particular socket will often upset the alignment slightly. If only a single tube is different, the change may not be enough to notice. But if they are all different theoretically the I.F. alignment should be touched up.

Bart had taken all the tubes out to a tube tester and replaced the weak ones. But he'd returned the tubes to their sockets without regard to their original position, satisfied as long as they bore the right number. The picture had sound bars bouncing in time with the performers' voices. The fine tuning would not eliminate them.

"Young fellow," I said condescendingly, "if you had taken the trouble to mark the I.F. tubes and the sockets you took them from, you wouldn't be faced with this trouble." I kept switching the I.F. tubes around until the bars had disappeared.

Bart seemed to take my riding all too peacefully. In fact, he gave me a free eye test and handed me a prescription for glasses.

Later I found out why all the kindly professional solicitude.

"Okay, who's the wise guy," the optician snorted, handing me back my prescription. "This prescription will get you nothing but plain window glass."

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Our Secret Radar War with Russia

[Continued from page 69]

an air-defense system, the other a coastal installation that monitored ships in the Mediterranean. The coastal radars were the concern: Could their antennas swivel up to take over after the air-defense sites were knocked out?

A ferret (a B-24 then) answered the question quickly and neatly. Equipped with receivers for both the coastal and air-defense radar frequencies, plus a jamming transmitter to neutralize the air-defense setup, it sortied over. Promptly the air-defense radar locked onto the intruding B-24. The raven flipped on his jammer. A few minutes later, he was in a radar beam again—from the coastal antennas. That was what he wanted to know and he got the hell out.

Listening in on everything. There's lots more than radar for an expert raven to find. He could intercept secret radio communications. If he's lucky (or well informed) he could happen onto a missile firing. Many missiles are guided by radio. A recording of the guidance signals reveals, to expert electronic analysts, how the control system works. Then you can dream up ways to louse it up.

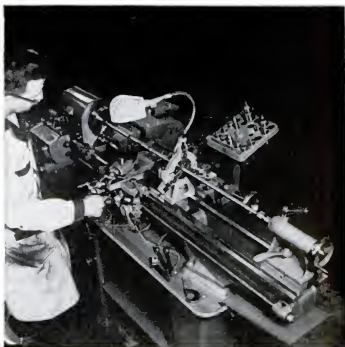
Today the lousing-up could involve very sophisticated deception. You might send out fake signals to trigger the other guy's missile into blowing up in mid-air. Or you could nudge its steering mechanism into a full turn so that it doubles back to wipe out its own launching base.

The trickery was cruder, but more exciting, in World War II. Then, the Nazis dispatched agents with portable radio transmitters to talk their bombers in over London. The British got onto the same frequencies with conflicting directions (in fluent German). The ether was often filled with genuine and counterfeit screams of "Fake! Phony! Don't listen to that *Schweinhund!*" Some Nazi pilots got so mixed up they landed in England.

It is even conceivable that a raven could eavesdrop on the countdown preceding a missile firing. The launching officers relay their orders over a public-address system. This broadcasts extremely weak, low-frequency radio signals.

The countdown would give away many details of the missile's design. You might also be able to tell if the firing was a test, a space shot, or a real for-keeps war

CONTINUED



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Our Secret Radar War with Russia
missile. Countdowns for liquid-fueled ICBMs take hours, so this kind of warning is much better than one from a radar fence like BMEWS, which at best might spot an ICBM 15 minutes before it hits.

ECM and ECCM. The main job of the ferrets, however, is to bring back data that show how to neutralize the other side's radar. The ways of doing this—electronic counter measures, or ECM—are many and devious. And for every ECM there is an ECCM—electronic counter counter measure.

Confusion. You can jam a radar by aiming a powerful beam of static at it. This mottles the scope with "hash" so that the operator can't identify the few blips representing the real intruders.

Such brute-force jamming gives you away. Jamming of our DEW Line and BMEWS would be tantamount to a declaration of war.

Besides, new radars can duck this kind of jamming. It must be concentrated in a narrow frequency range, and they switch frequency quickly.

A very cute jamming preventive is "cuddle-up." You set your radars to a frequency close to one your opponent uses. If he jams you, he jams himself.

Deception. This is better than confusion because the radar operators don't know they are being misled. You may use decoys—harmless targets to lure defense forces away from a real intruder. One U. S. decoy missile is the Quail, a small rocket cleverly shaped to reflect radar waves strongly. On a scope it looks like a big bomber. Just before the Normandy invasion in World War II, motor boats carrying similar radar reflectors made feints against the coast. The German radarmen thought they were warships.

One of the most ingenious deception gizmos is the Spoofer, which is carried aboard the intruding craft. It picks up the radar beam, amplifies it, and sends it back to the radar station—a fake echo more powerful than the real one.

At first the fake is timed to coincide with the real echo. But only until the searching radar locks onto the intruder. The defensive operator now thinks he has his target. He does, but not for long. The Spoofer gradually slows down the pulses it sends. The radar, which is usually designed to track strong echo pulses, fol-

Our Secret Radar War with Russia

lows the fake and disregards the genuine echo. Since it calculates range by measuring the time between echo pulses, the intruder seems to be going away from the target when it is actually approaching.

Invisible missiles. If you could build a missile entirely of the plastic used for radar antenna housings, radar waves would go right through it. No echo could get back to show on the scope.

Coatings that prevent radar echoes would be almost as good, and it is known, despite a dense fog of secrecy, that they do exist. One type works like the anti-reflection coatings on camera lenses. It uses two reflecting surfaces accurately spaced. The radar waves bounce back and forth between the two surfaces, canceling themselves out. Unfortunately, the coating must be designed for particular frequencies, and won't work at others.

Plastic coatings that soak up radar waves like sponges are sold commercially (to line test rooms). In them, the radar energy is converted to heat, so that little is left to be reflected.

Ferrets in space. Tomorrow's electronic warfare will be more complicated—and more necessary. Missiles strike with almost no warning.

Ferrets will be artificial satellites, launched to survey every inch of the globe every day. (The U. S. has two, Samos and Midas, just about ready.) They'll be hard to shoot down. But if they orbit low enough to snoop effectively, they'll be easy to spot and track—and jam. They might report back nothing but gibberish, or worse, electronic fairy tales.

Radar defense is giving way to infrared detectors. These send out nothing, but spot an intruder by the heat its engines throw off. That means you can't ferret them (could you tell if somebody was taking your picture?). They're also quite safe from jamming (although maybe you could blind them with an electromagnetic heat ray). But you can decoy them with flares and fireworks.

Missiles are switching over to inertial guidance, which steers by automatic dead reckoning—no radio signals, no radar, not even infrared. To jam that, you'd have to distort time or twist gravity.

Yet all these modern marvels depend on wheels and gears and electronics. Somewhere they are vulnerable.

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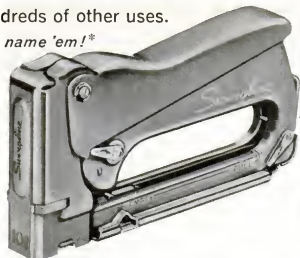
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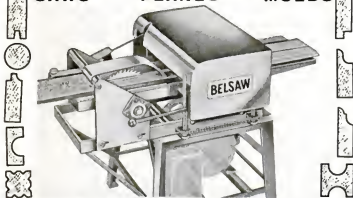
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The 200-M.P.H. Bocar

(Continued from page 116)

gauge. The manufacturer suggests killing the fanless engine when waiting for long traffic lights, but you notice that the temperature rarely climbs over 180 degrees, even during prolonged idle.

Acceleration is fantastic. Once out of the city limits, you make for the nearest superhighway to try the Bocar at speed. From a standing start, it takes the needle just over four seconds to swing past 60. You're almost tempted to open it up all the way and see whether it'll really do the advertised 200 m.p.h. The cold wind sweeps over the low windshield and buffets your eyes. You make a mental note to pick up a pair of goggles soon.

You take your hands off the wheel for a few seconds and the car continues unwaveringly on course. The departure point, or widest part of the body, is far forward to create a vacuum from that point back; with this design feature, even the smallest-wheelbase car practically steers itself. You feel safe in the cockpit; you're completely enclosed by the sturdy chrome-moly space frame. There are no rattles. Instead of being bolted to the frame, the body is secured by fiber-glass strips wrapped around the tubes.

Sharp turn coming up. You decide to wring 'er out, so you step on the gas. The car tracks easily with no lean, and refuses to break loose.

If you're no sissy, you'll spend several hours on the road that first day before you decide to head homeward. And you'll be in for a pleasant surprise when you stop at the service station. Though fuel economy dips as low as three m.p.g. with hard driving, you can expect to get in the high twenties under cruising conditions.

The options. You have your choice of four body styles ranging from dual-purpose models to the over-200-m.p.h. competition Stiletto. Though the Corvette power plant is standard, any other engine, modified to any degree, can be installed. A Rootes-type supercharger is available at extra cost. The machined hubs accept either Borrani wire or disk wheels. Gas-tank size, brake-lining material, and road clearance also can be varied to suit you. What's more, if you're a do-it-yourselfer, for about \$4,325 you can get a kit complete except for engine.

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Buffalo 7, N. Y.

10,000 Miles in an F-85

(Continued from page 89)

coming loose at high speeds. It fluttered. Luckett: The gas gauge went out.

Rowsome: Look, these are things you beat on the dealer about with almost any new car. I haven't heard a solid criticism yet of design and construction.

Markovich: Okay, how about the crack in the windshield?

Luckett: It's strain on the glass. It could happen in any car. Incidentally, I fixed the hood with a minor adjustment of the right-hand catch.

Ortner: The doors were a pain in the neck. Sometimes they took three or four slams to close.

Francis: This may be because the body is so air-tight. That would make it hard to slam the doors closed.

Luckett: Well, it's rain-tight, anyway. And one more thing. The engine starts right off when it's cold, but when it's hot, you do a lot of cranking. Maybe that automatic choke needed some balancing.

Fermoye: There's a point here that we shouldn't overlook. The layout under the hood is a mechanic's dream. Very easy to get at the plugs and distributor. It ought to save money on tune-ups and repairs.

Safety and Comfort Features

Markovich: You can't drive with that one-piece tailgate open for ventilation. Which means that if you like fresh air, you have to pay extra for a crank-down back window.

Ortner: At night the instrument panel is reflected in the side vent window. And the wind noise! Unless you closed all the windows, it battered your nerves. And the right sunshade hits the rear-view mirror.

Francis: For shame! My wife fixed that with one blow of her pale little fist.

Luckett: The left sunshade is so close to the driver's head that it's annoying. Another thing—the slope and positioning of the windshield puts the frame almost directly over your head.

Francis: Yes, for a six-foot-three guy like you.

Luckett: On the other hand, the under-cowl vents are fine. They keep your feet cool when it's hot outside. The heater-defroster is excellent, too.

Markovich: Seemed to me the instruments and controls are easy to reach.

10,000 Miles in an F-85

And, in my book, pedal spacing is good.

Luckett: The seats are about as comfortable on a long haul as in my Detroit car. But the back of the driver's seat could be higher and contour improved.

Styling

Markovich: The upholstery is conservative and—what's that word?—tasteful.

Ortner: My wife was appalled at the upholstery design.

Francis: You shouldn't have married an interior decorator.

Rowsome: It's a pretty car. The station-wagon contours struck me as fine in everything but that set of sheet-metal pleats along the side.

In Conclusion

Ortner: I'd say the Olds F-85 is an honest, dull citizen of a car. It's without eagerness, joie de vivre, elan.

Francis: He's talked that way ever since he took that trip to Europe.

Luckett: A workout in the F-85 is all you need to lay to rest the old idea that you have to have a heavy car to get stability at high speed and a smooth ride.

Fermoye: I prefer the handling of this Olds wagon to that of any other U. S. compact I've driven except the Valiant.

Rowsome: It's a capable automobile, easy to feel at home in, but without much personality.

Markovich: For me, it's not an exciting car, just a happy compromise that should please plenty of motorists.

Francis: Exciting or no, it's first rank among the U. S. compacts.

Luckett: It's a car that you still like after a 900-mile day—and there aren't many cars like that.



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Biggest Desert to Bloom Again

[Continued from page 111]

markable for their beauty alone, but in addition they record what happened to the Sahara over a period of 5,000 years.

The earliest (about 8,000 B.C.) show Stone Age men in a jungle setting of crocodiles, lions, and elephants. There was plenty of water then. Gradually sun, wind, and rapid temperature changes eroded the land. The later paintings change to scenes of grazing animals and less luxuriant terrain.

Then, as herders more and more replaced hunters, flocks grew and the soil's fertility faded. Foraging animals can destroy land even faster than weather does. By historical times, when the Romans introduced camels there, and the Arabs goats and donkeys, some of the worst offenders, the desert became a grim reality.

Some races died out or moved to the Sahara's rim. Others grew into fierce nomadic tribes. These would thread hundreds of miles across the desert in search of camel fodder, or else raid the border settlements for slaves.

By the twentieth century, the Sahara had grown into the world's largest desert—3,000 miles wide in some places, nowhere less than 1,000 miles across. It covers 2½ million square miles, and has fewer people per square mile than any place on earth except the poles.

Pierced by the stark, crystalline Hoggar Mountains at its center, cobwebbed by dried river beds, and cut by deep fingers of eroded plateaus and cliffs, the Sahara looks much like the surface of the moon. It has a temperature range almost as severe. Some places in it heat up to 130 degrees by day and cool to 11 at night.

Desert development. The French government hopes to change all that now. In 1957, it set up the Common Organization for Saharan Regions—a development agency for the two-thirds of the Sahara that is part of the Franco-African community. Encouraged by the news that there is plenty of water, C.O.S.R. and private agencies set out to chart the wealth of the Sahara and tackle its No. 2 problem: transportation.

Automobile pioneers in the twenties made dramatic desert crossings in caterpillar-treaded Citroens or six-wheeled Renaults. Today, specially designed die-

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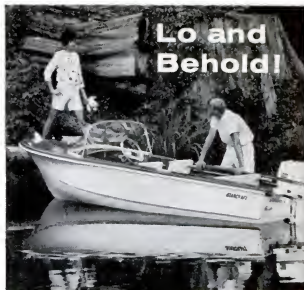
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Biggest Desert to Bloom Again

sel trucks are used on a handful of north-south roads. These roads are still unpaved two-laners. C.O.S.R. plans to extend and improve them as well as build new ones.

The trouble with road building, or, for that matter, rail, pipeline, or airfield construction, is that it must go hand in hand with water development. Routes will probably have to run where the water is cheapest to obtain. Builders must chart all potential sources. They must employ ingenious methods such as the "foggaras"—horizontal channels that carry water from water tables in higher areas to lower ones—or use windmills or diesel pumps to raise water from the reservoirs far underground.

All such development is enormously expensive. But there's no question of its value: the pay-offs are expected to be extraordinary.

Another Saudi Arabia. Oil obtainable at Hassi Messaoud alone is estimated at more than $3\frac{1}{2}$ billion barrels. Most wells are Class A types with a potential yield of 50 million barrels. Southeast, at Edjeleh, the eight fields discovered so far will bring in an additional two billion barrels. Still farther south, in a barely tapped area, a new well gushed so promisingly the first day that drill soundings were immediately increased in the area.

All this oil is light-rich in gasoline. It's rich in natural gas, too, a fuel that can be put to immediate use for power in the Sahara. (A cubic foot of gas has the same energy as $3\frac{1}{2}$ pounds of coal.)

At Hassi Messaoud the gas-oil ratio is about 1,000 cubic feet per barrel. Even in the early stages of production this will add up to a yearly output of 73 million barrels of oil and 70.6 billion cubic feet of gas.

To transport this oil, major pipelines are needed. One new 24-inch 415 miles long will deliver 30 million barrels of the gas-rich oil a year.

Natural gas also exists in the Sahara by itself. South of the Algerian border, at Hassi-R'Mel, is a field with known reserves of 30 trillion cubic feet. Other rich stores have been found at sites too remote to exploit yet. French technologists are already discussing how to ship this gas overseas—possibly by liquefying it and carrying it in supertankers.

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Perhaps one of the most shocking revelations, in the chapter titled "Vitamins and Voodoo," deals with the extremely wide variance of Vitamin and Vitamin-Mineral combination prices.

We reprint the following paragraphs by special permission.

"Actually, any particular vitamin bottled under one label is, for all practical and therapeutic purposes, the same as it is when bottled under another label. As a matter of fact, most of the vitamin concentrates consumed in our country are produced by only a few companies.

"The list of ingredients in a vitamin compound is one thing the consumer can almost always depend upon to be correct. Any company which fails to label the bottle with the exact formula and amount (or unit strength) of each ingredient risks a seizure by the Food and Drug Administration.

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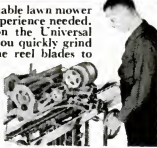
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Other surveys of the western Sahara, still literally only scratching the surface, point to 500,000 tons of copper and a million tons of manganese, as well as abundant supplies of coal, lead, titanium, and gold.

Meanwhile prospectors cast glances at the heart of the Sahara and the monumental heights of the Hoggar Mountains. Here they expect to find uranium.

Solar furnaces. Still more revolutionary plans for developing the Sahara may follow the geologists' surveys of water and mineral wealth. While these may make the desert green and rich again, it will still be a hot place to live. Fine, some French scientists are saying. The climate is ideal for solar-energy installations. The place is so close to the equator that the sun's rays are almost direct, and its heat is both intense and dry. That combination is the most economical for harnessing the sun's energy.

Siphoning the sea. But two other projects may frustrate that dream of solar power. They might really change the Sahara's climate. Both are Jules Verne visions of creating artificial seas in the desert—thereby producing large areas of evaporation, and, hence, clouds and rain. One, in the Egyptian part of the Sahara, would literally siphon the Mediterranean to fill the huge (7,500 square miles) Qattara Depression—a desolate sinkhole covered with rock salt and quicksand.

Another would dig a canal 28 miles long from the Mediterranean along the Algeria-Tunisia border and connect it to a series of partially dry salt lakes below sea level.

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